The FOUNDRY

October 1917

CLEVELAND, OHIO.

Vol. 45, No 10 Whole No. 302

Spirit of Service Pervades Foundry Meeting

American Casting Industry, In Ringing Resolutions Adopted at Boston Convention of Allied Associations, Pledges Its All to Win the War

CONSONANT with the spirit of the great enterprise on which our country is launched, the keynote of the 1917 convention of the allied foundry organizations, held in Boston during the week of Sept. 24, was unstinted, unmeasured service to the government concentrated to one end —*victory*. Foundrymen were present from all sections of the United States, from the rocky hills of Connecticut to the far flung shores of the Pacific ocean. Without exaggeration it may be said that Boston entertained the most representative body of casting manufacturers in the history of modern foundry development. In the minds of all, the idea of service was uppermost. This theme recurred again and again throughout the week. It was specially emphasized in the annual addresses of Presidents Pero and Jones, in the annual report of the board of directors of the American Foundrymen's association, in the paper on cast-iron shells by Major Edgar Allen Custer, in the resolutions adopted at Thursday's session, in the banquet addresses of Judge Moore and John A. Penton, and in the comprehensive paper on the details of ordnance construction presented by Major C. M. Wesson of Watertown arsenal. In addition, the same thought of organizing for maximum effort to win the war underlay the proceedings of the American Institute of Metals, which devoted an entire session to the use of nonferrous metals in munitions. Finally, in his concluding remarks as presiding officer of the convention, J. P. Pero, retiring president of the American Foundrymen's association, pledged the resources and enterprise of the foundrymen of the country to the solution of every problem in casting manufacture that the war's demands may bring to the front, insofar as such problems may be made to yield to continued, concentrated attack by trained minds backed by ample equipment and unlimited funds. In his brief speech of acknowledgement, following his induction into office, Benjamin D. Fuller, the newly elected president of the A. F. A., reiterated Mr. Pero's pledge and touched on the splendid co-operation that may be expected from every casting manufacturer. The attendance at the Boston convention was larger than at any previous meeting of the allied foundry organizations. The total registration of the American Foundrymen's association was 1179, that of the Institute of Metals was well over 100, the registration in the exhibition department was approximately 1800, and the total attendance during the week, therefore, in excess of 2500. The program was replete with interesting papers, addresses and discussion. There were 55 titles on the American Foundrymen's association program and 36 on the schedule of the Institute of Metals. The preprinted papers distributed by the American Foundrymen's association at the various technical sessions aggregated 650 printed pages, the largest number in the history of the organization. The twelfth annual foundry and machine exhibition went "over the top" with a vengeance. With 163 exhibitors, whose displays fully filled both great floors of the Mechanics' building, the show eclipsed all previous attempts. It was the second exhibition conducted under the joint auspices of the American Foun-

BENJAMIN D. FULLER
General Superintendent, Westinghouse Electric & Mfg. Co., Cleveland, Elected President of the American Foundrymen's Association at the Boston Convention

drymen's association and the American Institute of Metals, and its success confirms the wisdom of the innovation launched last year at Cleveland. A complete description of the exhibition follows this report.

With an impressive flag-raising ceremony on the stage of the Grand Hall of the Mechanics' building, the twenty-second annual meeting of the American Foundrymen's association and the twelfth annual foundry and machine exhibition were formally opened at 3:00 p. m., Monday, Sept. 24. Following the flag-raising, the address of welcome was made by the Hon. James M. Curley, mayor of Boston. In addition to the usual felicitations, Mayor Curley complimented the iron, steel and foundry trades on their magnificent support of the war. He also expressed himself as warmly in favor of the settlement of price fixing problems on a basis equitable to producers and designed to stabilize wages and stimulate production.

Boston's Mayor Welcomes Foundrymen

Immediately following Mayor Curley's address, adjournment was taken to Paul Revere hall where the opening joint session of the American Foundrymen's association and the American Institute of Metals was held. The meeting was called to order by J. P. Pero, retiring president of the American Foundrymen's association. He reintroduced Mayor Curley, who extended his remarks begun in the Grand Hall at the flag raising ceremony. "Nearly every city and village in the land," he said, "has its soldiers' monument, but what we need is more monuments to peace enforced by a free people and to the constructive achievements of peace."

"A convention such as this now being held in Boston," he continued, "is a great monument to constructive effort, and it is gratifying that such a meeting should be held in New England, the cradle of American liberty, in the midst of the greatest war ever waged. It augurs well for the future."

The response to the address of welcome was delivered by R. A. Bull, past president of the American Foundrymen's association and general manager of the Duquesne Steel Foundry Co., Pittsburgh.

J. P. Pero, superintendent, Missouri Malleable Iron Co., East St. Louis, Ill., retiring president of the American Foundrymen's association, delivered his annual address immediately after Mr. Bull's response. It traced the progress of the association during the past year and outlined some of the problems foundrymen must solve in the immediate future. The salient features of the address are quoted below:

"I am sure you will pardon my pride as a New Englander in presiding over this convention in the principal city of New England,—Boston—the Hub of the Universe. Previous to this meeting, we have held but one convention in New England, at Boston, in 1902, 15 years ago. As a matter of history, perhaps not generally known particularly by some of our younger members, let me remind you that 15 years before the Boston convention, and nine years before the first convention of the A. F. A., the New England Foundry Foremen's association was organized in Springfield, Mass., in 1887.

"That, so far as I have been able to learn, was the first association of this kind ever organized. It included in its membership the leading foundry foremen of that period in New England, some of whom are here today, while others are represented by their descendants. It was my good fortune to conceive the idea of such an association, perform the preliminary work for the first meeting and preside at the opening session of this first association organized for the interchange of views and experiences in foundry practice, and for the general uplift of the foundry trade.

"As foundrymen, we point with pride to the wonderful progress made in foundry practice in the past 25 years, and as members of the A. F. A. we are justly proud of the prominent part our society has played in contributing to the present state of development. We have accomplished much, but we have only begun. I believe we have reached only the threshold of progress. The door is open for still greater improvement, and I predict that those of you who attend our session 25 years hence, will marvel at the gigantic strides made during that period, even as now in retrospect we wonder at the progress already made.

"In these enlightened times the questions of the health, safety and comfort of employes are receiving much consideration, both from humanitarian and commercial standpoints. Also foundrymen, in common with leaders in every industry, have awakened to the realization of the enormous and unnecessary losses caused by fire.

"One of the supposedly important features of progress during the past 25 years in the foundry, as well as in other industries, is known as specialization; but specialization, like many other seemingly good things has its limitations, and we are at last beginning to realize that specialists are not thorough mechanics. As a consequence, we now face a problem of the utmost importance. It matters not to us, whether the present condition has been brought upon us by the desire of the employer for increased production, or decreased cost, or both, or whether the attitude of the labor unions in restricting the number of apprentices is responsible for existing conditions. We do know that unless steps are taken to make the foundry industry more attractive to our young men, and an efficient system of training and indenturing of our apprentices is adopted, we will have very few capable all-around molders in the next generation.

"Much is being written and said at this time of war profits. I cannot conceive of the possibility of abnormal profits under present conditions of increased cost of materials and labor. There may have been large war profits distributed among a few before the United States went into the war; there certainly were many losses, too, during that period. But I have so strong a faith in the loyalty and patriotism of American foundrymen that I have no hesitancy in affirming that they are above taking advantage of our country's needs and that their chief desire is to see an honorable and lasting peace restored to a world undergoing the throes of a cataclysm such as never before has been known in history.

In the rehabilitation of Europe we are destined to play an important part, and in my judgment the problems we now face in the conduct of this war are but preparation for greater problems in the future. We may rest assured that the American skill and energy will successfully cope with any condition which may arise."

New Officers

American Foundrymen's Association

President
BENJAMIN D. FULLER
Westinghouse Electric & Mfg. Co.,
Cleveland

Vice President
STANLEY G. FLAGG III
Stanley G. Flagg & Co.,
Philadelphia

Secretary-Treasurer
A. O. BACKERT
The Penton Publishing Co.
Cleveland

Address of Jesse L. Jones

The annual address of Jesse L. Jones, Westinghouse Electric & Mfg. Co., Pittsburgh, president of the American Institute of Metals, was delivered immediately after the address of Mr. Pero. In his remarks, portions of which are presented on the following pages in the report of the proceedings of the American Institute of Metals, he traced the progress of the nonferrous metal industry under the past year of war conditions, referring especially to the development of the commercial production of electrolytic zinc and to other technical advances.

The reports of the board of directors and secretary-treasurer of the American Foundrymen's association were read in abstract by A. O. Backert, secretary.

The report of the board of directors contains copies of correspondence between government officials and the officers of the association regarding a proposal to send a representative committee of foundrymen abroad to study the manufacture of shells and grenades in French foundries. This suggestion was not acted on favorably at Washington. Copies of correspondence with the secretary of war regarding an exhibit of war materials at Boston and with the President pledging the services

of the association for the vigorous prosecution of the war also are included in this report. In addition, the details of the association's business activities during the past year are given in full.

The leading features of the report of the secretary-treasurer are as follows:

"It is gratifying to report that during the fiscal year, ending June 30, 1917, the membership of your association passed the 1000-mark and on that date the enrollment attained a total of 1017. In the 12-month period from July 1, 1916, to June 30, 1917, 147 foundrymen were admitted to membership, of which 124 were active and 23 associate. The resignations aggregated 48, and 49 members were dropped for non-payment of dues. While the total book membership was 1017 on June 30, the total paid enrollment on this date was 970, as compared with 918 the previous year. Therefore, the actual paid membership showed a gain for the year of 52 or 5.5 per cent. The associate membership on June 30, this year, was 124, against 150 a year ago, a decline of 26. This apparent lack of interest in the affairs of your association by those entitled to this associate privilege is to be deplored and it is suggested that the active members endeavor to enlist the interest of their superintendents and foremen in the activities of this body. Ever since the Associated Foundry Foremen were merged with this association, the associate membership has steadily declined. It is possible that these members feel that the material benefits derived from such affiliation is not in proportion to the expenditure and it is suggested that a reduction in the price of *The Transactions* be made to associate members who desire to retain the record of our annual meetings in permanent form. Although several successful campaigns for membership have been conducted during the year, nevertheless the aid and support of the members is urged in enlisting the interest of foundrymen generally in the work of our society.

"The expense involved in conducting the affairs of your association has increased steadily and while the treasury showed a balance at the end of the fiscal year, nevertheless it might be necessary to increase the dues slightly to cover the added cost of operation. Several technical societies have been compelled to take this step, and while it is not urged for immediate consideration, nevertheless, constantly mounting costs may compel this action within a year to provide sufficient revenue to conduct the affairs of the association. The board of directors authorized the employment of an assistant to the secretary at a salary of $50 per month. He is serving largely in an editorial capacity and has greatly reduced the burden of the secretarial office.

"Increased operating expenses were more than balanced by the enhanced revenue, the receipts having exceeded the disbursements by $391.13 and the cash on deposit June 30, 1917, was $594.85, as compared with $203.72 the previous year. The total receipts were $16,582.60, of which $1000 were transferred from the profits of the Cleveland exhibition and $337.11 were set aside as a research fund to be drawn upon for special investigations to be authorized by the board of directors. This fund was established by the local committee in charge of the entertainment and reception of the foundrymen at Cleveland last year and represented the balance in the local fund after all expenses were paid. Thus far it has not been drawn upon and it is hoped that it may be increased materially before special work is authorized. The inventory of supplies, furniture and fixtures, emblems, unpaid balance due on the exhibition account and the balance of the American Foundrymen's cost work account aggregated $1,932.07. The disbursements were $16,191.47, the receipts having exceeded the expenditures by $391.13.

"At Cleveland last year your association undertook, for the first time, the management of the exhibition of foundry supplies and equipment and machine tools and accessories. The success of this venture is reflected by a balance of $6829.60 after the payment of all expenses. The total recipts were $27,127.93 and the expenditures $20,298.33. To the exhibitors was made a refund of 10 per cent of the cost of their space, $1000 was paid to the technical department and $166.50 to the American Institute of Metals. After all of these payments a comfortable balance remained, which was sufficient to assure the success of the Boston show without the financial assistance of the technical branch. In this connection the members of this organization may point with pride to the success attained in financing the big undertaking. No money was borrowed, nor was the technical fund drawn upon to defray any of the expense. The Cleveland exhibition financed itself and the surplus was sufficient to guarantee the payment of all obligations that would be incurred in the preliminary work preceding the Boston show."

A paper entitled "Fire Protection in Industrial Plants," by C. W. Johnson, Westinghouse Electric & Mfg. Co., East Pittsburgh, was read by title. This paper, which was contributed to the joint program by the American Institute of Metals, was accompanied by written discussions by F. O. Clements, Dayton Research Laboratories Co., Dayton, O., and Francis P. Sinn, New Jersey Zinc Co., Palmerton, Pa. Portions of Mr. Johnson's paper are as follows:

"The danger of fire is always present. It can be likened to a crafty, sleepless enemy, constantly watching and waiting for an indication of weakness in our defense so that it may strike when and where we expect it least. In considering the subject of fire protection it is necessary that we always look upon it in this light. There is no such thing as planning and arranging for certain protection and then going about our other business and forgetting the danger of fire. It is only by "eternal vigilance" that fires can be avoided, and it is only by the most complete preparedness that they can be promptly extinguished. "The whole theory of fire protection is expressed in the preceding paragraph; the trouble with us is that we are not sufficiently impressed with what it means. In many plants of small size there are frequently times when weeks, or even months may pass without a small fire, and vigilance and precautions accordingly lapse. In extremely large plants, comparatively small fires occur from time to time, and for that reason it is more easy to retain the necessary alertness. However, even under such conditions, after the repeated experience of having these small fires quickly extinguished, the majority of the responsible heads in the plant are apt to assume, as a matter of course, that those whose special business it is will always attend to their duty and prevent any serious conflagration. In this way a still greater menace is introduced in the carelessness which the factory heads develop with regard to the danger of fires. It therefore becomes necessary that there be some positive, driving force, ever present, to constantly, and at all times, hammer in the essentials of vigilance and preparedness.

"The subject of fire protection may be subdivided into: First, the elimination of the causes of fires; second, the protection against the spreading of fires when once started; and, third, the extinguishing of fires.

An impressive fact surrounding the causes of fires is that in almost every case they are caused by negligence and carelessness of the most obvious kind, and that they can be prevented by observing the most simple expedients and watchfulness. If we can but realize the truth of this statement and take it to heart properly, we will have taken the first step toward fire prevention. But someone must do this and do it

Board of Directors

American Foundrymen's Association, 1917-1918

H. R. Atwater, Osborn Mfg. Co., Cleveland.
R. A. Bull, Duquesne Steel Foundry Co., Pittsburgh.
Henry A. Carpenter, General Fire Extinguisher Co., Providence, R. I.
H. E. Diller, General Electric Co., Erie, Pa.
Stanley G. Flagg III, Stanley G. Flagg & Co., Philadelphia.
Benjamin D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland.
Alfred E. Howell, Phillips & Buttorff Mfg. Co., Nashville, Tennessee.
C. E. Hoyt, Chicago.
W. A. Janssen, Canadian Steel Foundries, Ltd., Montreal, Que.
S. T. Johnston, S. Obermayer Co., Chicago.
J. F. Kent, American Cast Iron Pipe Co., Birmingham.
V. E. Minich, Sand Mixing Machine Co., New York.
J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.
Maj. Joseph T. Speer, Pittsburgh Valve Foundry & Construction Co., Pittsburgh.
H. B. Swan, Cadillac Motor Car Co., Detroit.
A. O. Backert, Penton Publishing Co., Cleveland.

every day; and do it intelligently—not merely as a matter of form—and if the person is absent whose duty it is to attend to such things, then there must be some positive plan by which someone else will be present and will do the things that must be done. This is an attempt at saying what is meant by "eternal vigilance."

"To sum up the matter: We must do all we can not to let fires start. If they do start, we must have positive arrangements so that the fact will be known and announced at once. When this fact is announced, trained men with proper equipment must be gotten to the scene without loss of time, no matter whether the fire occurs at four o'clock Sunday morning, or during working hours, when all the employes are available for assistance."

Nominating Committee

The nominating committee, appointed at the Monday session, included R. A. Bull, Duquesne Steel Foundry Co., Pittsburgh, chairman; A. W. Walker, Walker & Pratt Mfg. Co., Boston; W. H. McFadden, past president, American Foundrymen's association, Ponca City, Okla.; Alfred E. Howell, Phillips & Buttorff Mfg. Co., Nashville, Tenn.; Arthur T. Waterfall, Dodge Mfg. Co., Detroit; S. T. Johnston, S. Obermayer Co., Chicago; A. B. Root Jr., Hunt-Spiller Mfg. Corp., Boston; and Stanley G. Flagg Jr., Stanley G. Flagg & Co., Philadelphia.

The resolutions committee, also appointed at the Monday session, was as follows: Henry A. Carpenter, General Fire Extinguisher Co., Providence, R. I., chairman; R. A. Bull, Duquesne Steel Foundry Co., Pittsburgh; Dr. Richard Moldenke, Watchung, N. J.; J. F. Kent, American Cast Iron Pipe Co., Birmingham, Ala.; Stanley G. Flagg III, Stanley G. Flagg & Co., Philadelphia; R. F. Harrington, Hunt-Spiller Mfg. Corp., Boston; and B. D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland.

Tuesday Morning Session

The Tuesday morning session devoted to general topics was opened at 10:30 a. m. in Paul Revere hall, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill., presiding. The papers presented and the discussion which they prompted dealt principally with the problems of co-operation between the engineering and manufacturing branches of the foundry industry and with the proper training of young men for positions of responsibility as foundrymen.

H. R. Atwater, Osborn Mfg. Co., Cleveland, in a paper entitled "The Foundry from the Viewpoint of the Sales Engineer", advocated better co-ordination of the work of the various foundry departments. Mr. Atwater first touched upon the labor problem, emphasizing the fact that labor is constantly demanding a larger share of the profits of the foundry industry. In commenting upon the attitude of foundry workmen, he said:

"It is generally stated as a fact that molders do not take kindly to molding machines, or in fact to the use of any other modern device that may be placed in the foundry. In many plants this has been demonstrated to be true, although the writer knows of plants where union molders in good standing work on molding machines and turn out a production in some cases 1000 per cent greater than was done when the work was made by hand. Moreover, the wage earned is more than double any union scale in the country.

"In stating this fact, it is not intended to open up a discsussion as to which is the better method—that of trying to work molders on machines or breaking in laboreres to operate them—but rather to bring up the question to the foundry industry and to ask if we are looking far enough ahead with a large enough vision to meet the requirements. Are we taking the opportunity to organize our plants and to equip them so that their production will not be cut down? This is the important thing whether we are operating with molders or so-called handy men. In these days when men are so scarce and the need of increased production is great proper means must be found to work both molders and handy men to their capacity.

The Engineer and the Foundry

"It is the writer's opinion that the success or failure of modern equipment and particularly molding machines in any given plant depends on the state of mind. Unless complete co-operation is given from the head of the plant down through the superintendent, foreman, patternmaker or others in charge, no very considerable success will be obtained from either the working of molders on the machines or the use of laborers. The thought and co-operation necessary to make a success must be such as to make a careful analysis of the cost of production on given patterns, an understanding of the proper rigging of the patterns and the kind of flasks to be used, and the price basis established on a quantity production that will largely increase the wage of the operator as well as bring a largely increased production to the plant. It is not possible to get a largely increased production unless the operators are to share in this increase."

Mr. Atwater also advocated the interchange of ideas on foundry operation and management as a means of promulgating the principles of better foundry practice. In conclusion he states that the hope of the industry in the future depends on the installation of power equipment and the training of laborers to successfully operate it.

F. J. McGrail, Struthers-Wells Co., Warren, Pa., read a paper on "The Relationship of the Engineering Department to the Pattern Shop and Foundry". Mr. McGrail's paper states that in some places ideal teamwork exists in foundry departments, but "it is a lamentable fact and a sad commentary on some of our industrial plants, that co-operation is conspicious by its absence. Many departments are continually working at cross purposes, when, if a closer relationship existed, costly errors in design and improper methods employed in the construction of patterns and core boxes might be eliminated."

Mr. McGrail laid special emphasis upon the evils of misunderstandings between the executives of the departments of a foundry. He also defined co-operation and pointed out how it can best be applied to the average foundry organization.

Mr. McGrail's paper continues in part as follows:

Need of Consultation

"If the writer were asked to name the one qualification most needed in the engineering service, he should unhesitatingly say: 'Consultation and planning with other executives.' Innumerable instances might be given where financial loss might have been averted if a little planning were done. One case may be cited as an example of bad practice, due to a lack of consultation and co-operation.

"The man in charge of the pattern shop and his associate in the foundry department are chiefly concerned with their labor costs, but this does not necessarily imply that a low labor cost of production in the pattern shop means an economical cost of production in the foundry. The methods employed in the construction of patterns and core-boxes to suit the equipment in the foundry, or other changes which might be easily made to facilitate a more rapid output of castings, are important factors in determining economy. If a slight increase in the cost of a pattern will largely decrease the cost of molding and core-making, it is safe to assume that the extra outlay is warranted, as it contributes much towards a better feeling between the two departments.

"Unfortuntely, one does not learn very much about anything in a lifetime, but if one would practice honest, persistent co-operation, it would be realized that one can frequently 'light his candle by the other fellow's flame', and if the work in the engineering department is brought to a successful and profitable conclusion, there is 'glory enough for all'."

Art Versus Science

Mr. McGrail's paper prompted an exceedingly interesting discussion of the ever present problem of the relation between engineers and the operating executives of foundries. Stanley G. Flagg Jr., Stanley G. Flagg & Co., Philadelphia, suggested that students of the problem sometimes lose sight of the difference between art and science as applied to the foundry. The foundryman is versed in the art of the industry, while the engineer deals with its scientific phases. Mr. Flagg won the emphatic approval of many of his listeners when he stated that much of the progress in the foundry industry has been due to engineers who have continually urged foundrymen to do the "impossible". Though the credit is due the engineer, the burden has fallen upon the foundrymen, who have transformed

the theory of the engineer to practical achievement.

J. W. Langston, G. & C. Hoskins, Ltd., Sydney, Australia, touched upon the Australian system of training foundry apprentices, showing that co-ordinated studies in the engineering and manufacturing branches give the Australian young men a blended knowledge and appreciation of the theory and practice of foundry management. For this reason, explained Mr. Langston, there are no grounds for controversy between the engineering and operating departments in Australian foundries. Mr. Langston paid a high tribute to the American engineers, saying that they have given the foundrymen the machines and equipment which have paved the way to the present high standing of America in the foundry industry.

Engineers First in Europe

J. P. Pero, chairman of the meeting, then summarized the situation, outlining what the engineers and the foundrymen have achieved, even though working at cross purposes. He referred to the evils resulting from the too prevalent practice of pitting one department against the other, especially in the matter of keeping down costs. Following Mr. Pero's remarks, a speaker called attention to instances in which the pattern shop is unjustly blamed for difficulties which properly should be charged to lack of co-operation on the part of the foundry. Richard Moldenke, Watchung, N. J., compared the management of foundries in Europe with those in the United States. In the latter country, most of the foundrymen are self-made men who have risen from the ranks by virtue of their experience and whose technical training has been acquired as an adjunct to the business of making castings. In Europe, and in Australia as well, the foundries are managed by trained engineers who were engineers first and practical foundrymen second.

Dr. Moldenke submitted the report of the advisory committee to the United States bureau of standards. The report shows that during the past year, at the request of Director Stratton of the bureau of standards, 25 samples of sand-blast sand were collected from various manufacturers for the purpose of testing them with a view to standardization. Micrographs of the sand and the results of the tests are presented in the report, which will be published in an early issue of THE FOUNDRY.

By unanimous vote the report was accepted and the committee instructed to continue its work of co-operation with the bureau of standards.

Dr. Moldenke submitted the report of the A. F. A. representative on the joint committee for the classification of technical literature. This report includes a suggested classification of foundry literature in which the various topics are grouped under the following headings: The foundry, generalia, the layout of the shop, equipment, raw materials, molding processes, melting processes, pouring methods, finishing processes, laboratory and testing methods, and the castings. Each of these general classifications are subdivided to include practically every item of foundry literature. The report was unanimously accepted and the representative was discharged.

FATHER AND DAUGHTER

J. P. Pero, retiring president of the A. F. A., with his daughter, May Rosalind Pero, soloist at the annual banquet, Sept. 27

W. B. Hunter, Fitchburg high school, Fitchburg, Mass., talked interestingly of the advantages of co-operative shop training. He outlined the course of study adopted at Fitchburg, whereby the student pursues his studies in the class room for one week and then is given training in the shop for a week, this routine being repeated every two weeks. Mr. Hunter pointed out that this system doubles the capacity of both the school and the shop. The boy who receives this kind of training is three years ahead of the boy who first completes his high school course and then devotes a number of years to the shop.

John Ritchie Jr., Massachusetts Institute of Technology, Boston, read a paper on "Facilities for Technical Training at Massachusetts Institute of Technology". Mr. Ritchie described the recent improvements at the institute and outlined the methods of conducting the engineering courses.

"Efficiency in the Foundry", a paper written by James A. Fitzgerald, Reno, Pa., was read by title.

Elect Directors for 1917-18

Benjamin D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland, presided at the Wednesday session on foundry costs and general topics. Sixteen members of the association, previously nominated by the nominating committee, were elected directors to serve for the year 1917-18. The names of the directors elected appear on page 413.

J. F. Kent, American Cast Iron Pipe Co., Birmingham, Ala., read a paper on "Improving the Relationship Between Employer and Employe". Mr. Kent's paper shows what has been done in a southern pipe foundry to promote a better feeling between the employers and workmen, and deals especially with the troublesome problem of handling negro labor. It also outlines the results obtained in the effort to promote cleanliness among workmen and explains how the negro employes were gradually brought to a full appreciation of the benefits of the medical department established by the company. This paper also describes the activities of the Y. M. C. A. and presents figures to show the attendance at educational classes, entertainment, athletic games, etc., arranged for the workmen. The attitude of the employer toward the welfare movement is summed up in the sentence "We believe implicitly that a man expects and has a right to expect, something more than that which he gets in his pay envelope, and that is what we are trying to give him."

Administering Welfare Work

R. A. Bull, Duquesne Steel Foundry Co., Pittsburgh, spoke of the danger of antagonizing workmen by adopting a paternalistic attitude. Welfare work must be administered unostentatiously to be effective. Another speaker referred to the benefits of "dry" legislation in the state of Alabama, stating that in Birmingham, which has a population of 190,000, the average number of persons in the city jail has dropped to 26 since the saloons were wiped out.

William Judson Kibby, Cleveland, presented a paper entitled "How Character Analysis Solves the Man Problem", parts of which follow:

"King Solomon said, 'As a man thinketh in his heart, so is he.' And may we add, that that which a man thinks in his heart, writes itself upon his face. Our thoughts do write themselves upon our faces. They are indelible and express themselves in little physical manifestations so that

Resolutions Adopted at Boston Convention

War Service Board

WHEREAS, the foundrymen of America represented in the annual convention now assembled of the American Foundrymen's association have a strong conviction that the government of the United States can and should receive at the hands of those engaged in the foundry industry in this country, more effective assistance than has hitherto been rendered by foundrymen in the successful prosecution of the war; and

Whereas, the American Foundrymen's association, a national organization of foundrymen engaged in the production of castings which has a purpose purely technical and educational, has in hand or can obtain from its membership, funds thought to be necessary for the purpose mentioned herein; therefore

Be it resolved that the American Foundrymen's association does hereby authorize and direct its president to appoint a War Service Board to consist of five of the ablest men engaged in the manufacture of gray iron, malleable iron, steel and nonferrous castings in the United States irrespective of their membership in any organization, who shall serve without compensation and shall give such assistance as a board operating directly, or as a central board governing subsidiary boards or committees, to the government of the United States, as may be possible with the approval of said government, in the securing of castings of proper quality, at desired rates of production, at fair prices, to meet the needs of said government; and in the conducting of any investigations into the manufacture of castings considered advisable in the furtherance of the objects mentioned herein; and

Be it further resolved that the proper officers of the American Foundrymen's association are hereby authorized, if considered advisable by the said War Service Board which shall be appointed with the approval of the United States government, to disburse such sums as may be necessary to defray the proper expenses for conducting the work of the co-operation with the United States government referred to in the foregoing; and

Be it further resolved that the directors of the American Foundrymen's association be and they are hereby authorized to take such steps as they may consider advisable to appropriate or secure whatever funds may be needed for the most effective co-operation proposed in these resolutions.

Declaration of American Foundrymen's Association

IMMEDIATELY following the declaration of war, your board of directors, by unanimous vote, adopted a resolution extending to the government the support of the foundrymen of America, which was transmitted to the President and received acknowledgment from the nation's executive office. This action was taken because of the impossibility of securing a prompt expression of opinion from our large body of members and because your board was certain that its action expressed the undivided sentiments of every casting manufacturer in the United States.

This association, now in annual convention assembled, not only ratifies the action of the board of directors in the adoption of this resolution, but again pledges every resource of the foundrymen of America to the government in the successful prosecution of the war in order that it may be brought to an early termination.

Therefore we the members of the American Foundrymen's association, representing the great steel, gray and malleable iron industries of the United States, will do all within our power to mobolize our plants and their output, placing them at the disposal of the government and will speed-up production to the end that the needs of our government will be more promptly met and in every other way we promise our aid and support to our country to hasten the defeat of our enemies.

Liberty Loan

WHEREAS, the members of the American Foundrymen's association realize that for the prosecution of the war large sums of money are needed, making necessary the sale of government bonds in addition to the sums raised by taxation, and whereas another issue of Liberty bonds is about to be made, therefore

Be it resolved, that the members of the American Foundrymen's association devote the same efforts to the sale of the second and succeeding issues as they so patriotically devoted to the first bond issue, and

Be it further resolved, that the employing members of this association render every possible assistance to their employes in the purchase of bonds.

Resolution of Thanks

WHEREAS, this convention of the American Foundrymen's association is one of the most successful in its history, and

Whereas, this is attributable in a very great measure to those who have toiled unceasingly in the reception and entertainment of the large number of visitors in attendance, and

Whereas, the technical program was unparalleled in number and excellence of papers on a variety of subjects of interest to gray and malleable iron and steel foundrymen, therefore

Be it resolved, that the members of the American Foundrymen's association extend their appreciation and hearty thanks to the New England Foundrymen's association and the members of the committees of that organization who have made our visit to Boston so enjoyable and whose hospitality was without bounds; to the City of Boston and its chief executive, Hon. James M. Curley; to the Chamber of Commerce; to the management of Mechanics building; to the authors who contributed to our program; to the exhibitors who made our show a success; to the daily press of Boston, the trade press of the country, the hotels, etc., to all who in any way contributed to the wonderful success of this, the twenty-second annual meeting of our organization.

those who are thinking honest, agreeable, generous, kindly thoughts have that kind of face. Those who are thinking dishonest, selfish, greedy thoughts, have dishonest, selfish, greedy faces. Those who are timid and cautious, have timid, cautious ways and faces. Those who have great physical energy, driving force, express such thoughts; and those who are cunning and foxy, have cunning, foxy faces.

Need of Character Analysis

"The question was asked of one of America's greatest executives as to what he thought was the greatest weakness of the coming executive, and he, after careful thought, came back with this answer: 'The lack of analysis.' The average individual cares little or nothing about analyzing and finding the whys and wherefores of the things he seeks to accomplish. In other words, he will not seek to find the units of the analysis; or after having found them, to carefully weigh each one; or after having weighed each unit, to place it back into the whole, thus getting a clear picture of the idea or thing from a wholly disinterested or unprejudiced standpoint. The age in which we live demands that individuals in pivotal positions, which call for opinions and judgments based upon fact, be analysts; and no one of ordinary intelligence will doubt this assertion."

Mr. Kibby emphasized some of the principles of character analysis by referring to charts showing the characteristics of various types of individuals. He also demonstrated the application of these principles by analyzing W. H. McFadden, past president of the American Foundrymen's association in a manner which excited favorable comment.

Victor T. Noonan, director of safety, industrial commission of the state of Ohio and chairman of the American Foundrymen's association committee on safety, sanitation and fire prevention was not present. Therefore the report of the committee was submitted by Richard Moldenke, Watchung, N. J. The letter of transmittal, accompanying the proposed safety and sanitation code, refers to the negative results of the conference held at Buffalo, July 30, and outlines the basis of agreement suggested by Magnus W. Alexander, General Electric Co., West Lynn, Mass. These suggestions, which were considered by the A. F. A. safety committee at an adjourned meeting in Buffalo Aug. 17, were not approved. Instead, the committee decided to ask the association to adopt the proposed code as finally revised by the A. F. A. representatives.

After reading the letter of transmittal, Dr. Moldenke moved that the association adopt the code as proposed. W. H. Barr, president National Founders' association; C. L. Newcomb, Dean Steam Pump Co., Holyoke, Mass.; Stephen E. French, Athol Machine Co., Athol, Mass.; G. P. Aborn, Blake & Knowles Steam Pump Works, East Cambridge, Mass.; and others spoke against the adoption of the code. With Mr. Moldenke's permission, the original motion was withdrawn and Mr. Aborn moved to refer the report on the safety code back to the committee for further conference with representatives of the National Founders' association. This motion provided that the revised code again be submitted to the association at the next convention. This proposal was discussed by Messrs. Barr, Newcomb, French and Aborn, Dr. Moldenke, R. A. Bull, Duquesne Steel Foundry Co., Pittsburgh; J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; A. O. Backert, Penton Publishing Co., Cleveland; Thomas J. Soults, Sill Stove Works, Rochester, N. Y.; W. E. Freeland, *The Iron Age*, Worcester, Mass.; W. H. McFadden, Ponca Oil Co., Ponca City, Okla., and others. When put to a vote, the motion was lost.

R. A. Bull then moved that the chairman, Benjamin D. Fuller, appoint a committee to go over the report on the safety code and hear the criticisms of those opposed to its adoption. This motion was passed.

Standard Cost System

In spite of high prices and wide margins of profit, it was evident from the interest displayed in the report of the cost committee that the importance of this vital subject is more widely appreciated now than ever before. The committee's report, which was presented by Benjamin D. Fuller, chairman, Westinghouse Electric & Mfg. Co., Cleveland, outlines the progress made during the past year in developing a standard cost system for the American Foundrymen's association. For the first time a definite plan has been evolved and tangible results achieved. An outline of the plan is given in the committee's report, which is in part as follows:

At the annual meeting of your association held at Atlantic City in 1915, the suggestion was made that the members of this organization raise a fund to promote the installation of a standard cost system in the casting plants of its members. The cost committee was instructed to make an investigation and devise a plan for carrying on this work. At the meeting in Cleveland last year progress was reported, but definite action was deferred inasmuch as it was believed by the members of the committee it would be exceedingly difficult to enlist the interest of foundrymen in cost-keeping methods during a period of such great industrial activity. However, preliminary investigations proved the feasibility of the plan tentatively devised and immediately following last year's meeting it was decided by this committee to formulate a definite plan of procedure and to undertake the financing of the special cost fund to defray the expense not only of preparing the standard cost system, but to install it in the plants of the members who subscribe to this fund.

Foundrymen Favor Cost System

Inasmuch as the American Foundrymen's association is without adequate means to carry on such special work, it was decided to limit the benefits of the standard cost system to those members of the association, and only those, who subscribe to this fund on the basis of the number of molders and coremakers employed. This productive labor, it was believed, furnished the best index to the capacities of the plants to be interested and the cost of carrying on this work was estimated on the average number of molders and coremakers employed. It was believed that if a fund of from $8000 to $10,000 were subscribed the success of the undertaking would be assured. Estimating the possibility of an initial 100 subscribers for a total of from $8000 to $10,000, it was decided to adopt the following schedule of charges: Foundries employing up to 40 molders and coremakers, $50; foundries employing from 40 to 200 molders and coremakers, $1.25 for each molder and coremaker employed; and foundries employing more than 200 molders and coremakers, $250.

It is gratifying to be able to report a total of 102 subscriptions amounting to $7246.25, and cash payments already received from these subscribers, representing 25 per cent of their total subscriptions, aggregate $1950.68.

Two meetings of the cost committee were held during the year, principally for the purpose of considering a plan of operation and to select a cost accounting firm to carry on this work. Propositions were presented by C. E. Knoeppel & Co., New York, and Scovell, Wellington & Co., Boston. At a meeting held at Cleveland, Friday, Feb. 16, 1917, no definite decision was reached and it was concluded to extend an invitation to representatives of both of these

Paul Revere

NEVER did the American Foundrymen's association assemble amid more appropriate surroundings than at the twenty-second annual meeting in Boston during the week of Sept. 24. Beautiful Paul Revere hall in the Mechanics' building was set aside for the major sessions. Architecturally effective and suggestive of the patriotism of New England's great pioneer foundryman, this beautiful meeting room harmonized perfectly with the week's proceedings. Inspiration was found in the mere setting of the convention.

concerns of cost accountants to explain in detail their respective propositions. On Monday, Feb. 26, a meeting was held at the William Penn hotel, Pittsburgh, which was attended by B. D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland, chairman; J. Roy Tanner, Pittsburgh Valve Foundry & Construction Co., Pittsburgh; H. J. Koch, Fort Pitt Steel Casting Co., McKeesport, Pa.; C. R. Messinger, Sivyer Casting Co., Milwaukee, and A. O. Backert, Cleveland. C. E. Knoeppel of the firm of C. E. Knoeppel & Co., was accompanied by W. A. McCall, a member of this firm, and C. H. Scovell represented the firm of Scovell, Wellington & Co. The representatives of both companies were afforded ample opportunity to present their propositions in detail. After considerable discussion, a letter ballot showed a majority in favor of awarding the contract to C. E. Knoeppel & Co., New York. Authority was obtained from your board of directors to enter into this contract and C. E. Knoeppel & Co., New York, were employed for the purpose of carrying on this work.

Industrial Education

In the report of the committee on industrial education prepared by Frank M. Leavitt, chairman, University of Chicago, Chicago, it is stated that it seemed to the committee that the greatest service it could render the association would come from the establishment of two or three experimental classes of actual apprentices, and in developing a course of study and practice for the apprentices that should have the approval of the employers themselves. The report continues:

"We also felt that such classes should be the result of co-operative action on the part of the employers and the public school system. It was planned, therefore, to have the classes conducted under the auspices of the public schools without expense to the employers or to the association.

All this has taken time and the committee can only report progress. However, some definite steps have been taken. For example, the committee has been assured by the director of vocational work in the Chicago schools that he will establish the courses for which we have asked whenever we will submit the course of instruction and provide the apprentices. The foremen assure us that they will do all in their power to assist in developing the course and in making arrangements to have apprentices take the work.

The report of the A. F. A. representatives on the conference board on training of apprentices, by Frank M. Leavitt, was read by title. A paper by Robert J. Anderson, Cleveland Metal Products Co., Cleveland, entitled "Micro-Metallurgy for the Foundry", also was presented by title.

The gray iron session Thursday morning was opened by the presentation of a note on the characteristics of fine facing molding sands, by C. P. Karr, associate physicist, bureau of standards, Washington, D. C. In reality this paper is a continuation of a report made to the American Foundrymen's association at Cleveland in September, 1916. It refers to the efforts that have been made to find in this country a facing sand to replace fine French molding sand. Results are presented of tests on the fineness, moisture content, specific gravity, melting point and tensile strength of three sands of American origin. The sand most nearly approaching the French sand so far discovered is mined near Zanesville, O.

The report of the A. F. A. committee on general specifications for gray iron castings was presented by title and adopted.

In a paper on "Briquetting Foundry Borings", by A. L. Stillman, General Briquetting Co., New York, the author describes extensive tests made with various mixtures of cast iron for miscellaneous castings and for locomotive cylinders. The physical properties of iron made from mixtures containing briquetted borings are compared with those of iron containing the usual percentages of scrap and pig. Mr. Stillman concludes from the results of the tests that briquettes have a very definite and promising future in foundry practice. He says that briquettes in no way injure the product of the cupola and that their use effects economy. He predicts that the low price of borings in the briquettted form as compared with the cost of heavy iron scrap will encourage the use of briquettes.

A splendid ovation was given Major Edgar Allen Custer, Philadelphia, following the presentation of his paper on "Cast-Iron Shells in Permanent Molds". This paper is published in full elsewhere in this issue of THE FOUNDRY. Major Custer followed the reading of his paper with a few stirring impromptu remarks that aroused the entire audience to prolonged applause. "We must make better castings than ever before," he said. "The best we can do is none too good for our boys in the trenches who we have sent out to fight and win this war for us."

Urges Uses of Cast Iron Shells

The discussion was opened by A. O. Backert, secretary of the American Foundrymen's association, who referred to the reluctance of our ordnance department to adopt cast-iron shells. "Shells of cast iron or semi-steel that are so successfully used by both our allies and our enemies ought to be serviceable to us," he declared. "This shell question is all important and must be solved correctly."

In reply to a question, Major Custer said malleable iron is more satisfactory than gray iron for hand grenades because of its superior toughness. Grenades, he pointed out, do not have to be designed to withstand the shock of being fired from a gun. B. D. Fuller referred to tests of cast-iron grenades which he said exploded to powder in a wooden box with walls 1 inch thick, without doing the box any material damage. Malleable-iron grenades, on the other hand, broke into larger pieces that were hurled through the sides of the box. Major Custer explained that ordinary foundry iron usually powders on being exploded; to obtain proper fragmentation a special iron somewhat similar to a wheel iron must be employed.

A paper entitled "Seasoning of Gray Iron Castings" was presented by the author, L. M. Sherwin, Brown & Sharpe Mfg. Co., Providence, R. I. It is published in full elsewhere in this issue.

Other Technical Papers Read

"Modern Centrifugal Cupola Blowers", a paper read by J. A. Shorey, General Electric Co., Schenectady, N. Y., was accompanied by a large number of interesting lantern slides. Other papers read at the Wednesday morning session include: "High Sulphur in Soft Gray Iron", by T. Mauland, Deering Works, International Harvester Co., Chicago; "Factors in the Economical Production of Small Cores in Large Quantities", by R. E. Kennedy, University of Illinois, Urbana, Ill.; and "Experiments to Determine the Most Effective Means of Mixing and Blending Foundry Facing Sands", by R. F. Harrington, Hunt-Spiller Mfg. Corp., Boston.

At the conclusion of the Thursday session, a number of important resolutions bearing on the relations of the foundry industry with the government in the present emergency were presented and unanimously adopted by rising votes. The full texts of these resolutions accompany this report. R. A. Bull announced that, if necessary, the association is prepared to spend $10,000 immediately in behalf of the war service board authorized in one of the resolutions. He also said other sums will be raised as needed. In brief the American Foundrymen's association put itself on record as unreservedly back of the government with all its financial resources and man power.

A paper on "Sand Blasting in the Foundry", by H. L. Wadsworth of the American Foundry Equipment Co., Cleveland, was read by Mr. Alexander of that company. Scarcity of labor and the growth of the safety movement in recent years have greatly stimulated sand-blast practice. Two methods are being pursued, hand and automatic. Both have their ad-

RANDOM SNAP SHOTS DURING CONVENTION WEEK

vantages, according to the size and character of the castings. The question of the abrasive is most important. Not enough thought has been given to the selection of the sand. Foundries, he said, are being converted to the use of a hard white sand which does not break up. B. D. Fuller of the Westinghouse Electric & Mfg. Co., Cleveland, said no better investment could be made than the installation of modern sand-blast equipment.

In his paper on "Solution of Foundry Transportation and Conveying Problems," Robert E. Newcomb of the Dean works of the Worthington Pump & Machinery Corp., Holyoke, Mass., described the principal items of equipment for lifting, handling and conveying materials in the foundry.

Wallace T. Montague, Norton Co., Worcester, Mass., described "Factors Contributing to the Econmical Use of Grinding Wheels in the Foundry".

Other papers presented at the Friday session included "Oxy-Acetylene Welding and Cutting", by Stuart Plumley, Davis-Bournonville Co., Boston, and "Refractory Materials Employed in the Metallurgical Industry", by H. C. Arnold, University of Illinois, Urbana, Ill.

A. L. Williston, Wentworth Institute, Boston, addressed the meeting upon the urgent and immediate need of concerted action in training skilled workmen and apprentices for the foundry. A motion prevailed that the executive board of the association be directed to name a committee to make an intensive study of this problem.

It was announced that the conference committee appointed to meet with the National Founders' association to draft a safety code would consist of Earl B. Morgan, Norton Co., Worcester; Ralph H. West, West Steel Casting Co., Cleveland, and the president acting ex-officio. This committee, which previously has been referred to, has not yet completed its work.

Visitors Well Entertained

As was the case of the Cleveland convention last year, the one-session per day arrangement allowed the visiting foundrymen and their friends freedom to enjoy the entertainment features planned by the local committee. On Tuesday afternoon several hundred convention visitors enjoyed a ride on the S. S. ROSE STANDISH in and about Boston harbor. A ball game between the Boston and Cleveland American league teams attracted many fans to Fenway park Wednesday afternoon. That evening members and guests of the allied associations attended a theater party at B. F. Keith's vaudeville house. Thursday a luncheon was held for the visiting ladies and during the afternoon they enjoyed an automobile sightseeing tour to various points of historical interest in Boston and vicinity. Many foundrymen were the guests of the General Electric Co. at West Lynn, where luncheon was served. During the afternoon the men were shown through the various departments of the extensive plant. A large number of foundrymen also visited the stove works of the Walker & Pratt Mfg. Co., Watertown, Mass.

The annual banquet, held Thursday evening in the Copley-Plaza ball room, was attended by nearly 500 members and guests of the allied associations. Alfred E. Howell, Phillips & Buttorff Mfg. Co., Nashville, Tenn., was toastmaster. May Rosalind Pero pleasantly entertained with a number of vocal selections. Judge Moore, New York, gave an after-dinner talk on "Dollars and Sense". John A. Penton, president, Penton Publishing Co., Cleveland, delivered a patriotic address, in which he described the remarkable achievements of France in producing munitions and carrying on the work behind the battle lines. Mr. Penton emphasized the fact that every person in France is pledged to the accomplishment of a single purpose—the winning of the war. In conclusion, he appealed to the men and women of America who remain at home to stand behind those who go to Europe.

Steel Sessions Draw Big Crowds

BECAUSE military experience and practice throws light on the work many foundrymen are undertaking, great interest was manifested in the presentation at the professional session Friday, by Maj. C. M. Wesson, ordnance department, United States army, Watertown arsenal, Watertown, Mass., of his paper, "Steel Castings for Ordnance Construction." In introducing the speaker, President Pero stated he felt confident that American foundrymen working closely with the United States army engineering corps, could master all problems relating to the production of ordnance castings which were possible of solution.

Discussing the paper, Mr. Wilson of the Connecticut Electric Steel Co., New Haven, inquired as to the best treatment of electric steel castings for ordnance. Major Wesson replied he had had no direct experience with making electric steel castings for ordnance, though the Watertown arsenal was about to install a number of such furnaces. Based on what he knew regarding the electric furnace process, however, he believed that since the latter gave a minimum of slag, the required physical qualities for guns could be met with less severe treatment. His experience had shown that in the acid open hearth by holding the metal with the gas off about 10 minutes in the furnace and 5 to 10 minutes in the ladle, the best results could be obtained. Frank Hodson of T. H. Watson & Co., Ltd., Sheffield, Eng., who is in this country introducing the Graves-Etchell electric furnace, stated that in England good steel castings for war use are being made in electric furnaces with basic linings. Castings made for "tanks", he said, showed 90 tons tensile strength, 25 per cent contraction and 20 per cent elongation. Major Wesson told of a test of gun forgings made from basic electric steel after duplexing in the basic open hearth which had shown very favorable results. He thought a splendid opportunity was open to the electric furnace method in filling the numerous orders for large and small guns which were about to be distributed among many companies in America.

R. A. Bull, Duquesne Steel Foundry Co., Pittsburgh, said the attitude of the foundrymen in the past had not been the attitude of the army ordnance experts as to specifications. All this has been changed by the present crisis. Today the steel foundrymen are on the same basis as the army. "All will do their part and will co-operate to the fullest extent to see that the government gets what it wants," he said.

A. H. Jameson, Malleable Iron Fittings Co., Branford, Conn., presided at the Thursday morning steel session. A paper entitled "The Use of Vanadium in Steel Castings" was read by J. Loyd Uhler, Union Steel Casting Co., Pittsburgh. It is stated in this paper that vanadium is not a new discovery, but it is only within the past few years that it has been employed extensively by practical steelmakers. It has the property of combining with both oxygen and nitrogen at high temperatures, therefore eliminating both of these gases from the metal. It also has the effect of causing the

carbon to be more uniformly knit together throughout the mass. In conclusion, the author gives the results of interesting tests on vanadium steel castings that were made to take the place of forgings in marine turbines. The castings were made to the following forging specifications. Tensile strength, 67,159 to 78,227 pounds per square inch; elongation in 2 inches, 18 per cent; bending test for 1-inch square bar, 180 degrees over 1½-inch mandrel. The tensile bars were 0.785 inch in diameter.

Mr. Uhler was asked if the titanium employed in these castings was added in the ladle. In reply he stated that it was introduced in the charge, and that the Union Steel Casting Co. prohibits the addition of the element in the ladle. When asked by E. F. Cone *The Iron Age*, New York, if the same practice obtains in the case of manganese additions, Mr. Uhler replied that the manganese is introduced in the ladle in lumps about the size of walnuts.

Describes Small Open-Hearth

An abstract of the paper written by David McLain, McLain's System, Milwaukee, describing a small open-hearth furnace, was read by Mr. Cone:

In the introductory pages of this paper, the author recounts some exceedingly interesting experiences in the early days of the steel foundry business. The operations of William Hainsworth, of Pittsburgh, who established the first bessemer steel foundry in this country, are described in some detail. Throughout his life, Mr. Hainsworth was confident a successful small open-hearth furnace could be built, and he spent thousands of dollars experimenting with apparatus of this character. He never, however, succeeded in realizing his ambition.

The McLain-Carter small open-hearth furnace, which this paper describes in detail, is built in sizes ranging from one to five tons. Oil fuel is used. The oil consumption is stated to be 65 to 70 gallons per ton of steel. The roof, it is claimed, will stand for 500 to 700 heats, with the furnace turning out high-temperature, fluid metal.

Mr. McLain appeared after the abstract of his paper had been read and answered a number of questions regarding the operation of the furnace in question. Anketell Henderson, Commonwealth Steel Co., Sydney, Australia, asked if the melting unit described in the paper is adapted to gas fuel. In reply, Mr. McLain stated that he had experimented with gas while developing the furnace, but that better results had been obtained with oil. He also explained that about 70 gallons of oil are consumed per ton of metal when the furnace is operating on a basis of five 2-ton heats in 12 hours. The fuel, said Mr. McLain, costs from 4¼ to 5¼ cents per gallon. In addition to the oil used while the furnace is in operation, about 100 gallons are consumed during the night to keep the walls hot. Approximately 200 gallons are required for this purpose every 24 hours when the furnace is idle. The conversion cost in a furnace of this type is from $7.50 to $8.50 per ton, including fuel, labor, overhead, depreciation, refractories, etc.

R. A. Bull, Duquesne Steel Foundry Co., Pittsburgh, questioned Mr. McLain as to the minimum section of castings that can be poured from metal produced in this open-hearth furnace. Mr. McLain cited a number of instances in which sections as thin as ⅛ inch had been poured. A Milwaukee foundry company using one of the small open-hearth units is pouring crucible molds and another company is making castings from malleable casting patterns without difficulty. Mr. McLain recommended that metal for castings of light section should be poured in heats not exceeding two tons.

Benjamin D. Fuller

BENJAMIN D. FULLER, recently elected president of the American Foundrymen's association is the ideal type of practical foundry executive. He has risen from the ranks to a high position in the industry through his own efforts unaided by an extensive formal education. He is the son of a Unitarian minister and was born at South Scituale, Cape Cod, Mass., Feb. 10, 1864.

He commenced his foundry career as an apprentice in the Pittsburgh Locomotive Works, now a part of the American Locomotive Co. at Allegheny, Pa., in 1876. After eight years as a boy in this shop he went with the Westinghouse Machine Co., Wilmerding, Pa., as a journeyman molder. In 1885 he was employed by the Fort Pitt Foundry for a year, thus gaining valuable experience in steel foundry practice. He also was for a time employed by the Fuel Gas & Electric Mfg. Co., Pittsburgh, which was later absorbed by the Westinghouse interests. In 1893 he was appointed assistant foreman of the old Allegheny foundry of the Westinghouse Electric & Mfg. Co. He advanced steadily and it 1906 was transferred to the Cleveland plant of the Westinghouse company as general superintendent. This is now one of the largest units in the great Westinghouse organization. Mr. Fuller has been associated with the Westinghouse companies continuously for 27 years.

New Oil-Burning Apparatus

W. A. Janssen, Canadian Steel Foundries, Ltd., Montreal, Que., read a paper describing a new method of burning crude oil.

In reply to a question asked by Frank B. Runser, National Foundry Co., Erie, Pa., Mr. Janssen explained that an elbow and pipe bolted to the lower flange of the vaporizer is all that is required for a burner. The gas, he said, burns with a transparent flame similar to that in a soaking pit in steel practice. The size of the vaporizer, said Mr. Janssen, depends upon the oil consumption per hour.

Mr. Henderson asked if by-product tar can be utilized in the vaporizer, and referred to the possibility of clogging due to carbon deposits on the baffles of the apparatus. Mr. Janssen related the experience of a company which is using coal tar exclusively and also a mixture of coal tar and heavy crude oils. No difficulties due to deposition have been encountered and on several occasions the examination of the baffles has shown no trace of carbon.

Adopt Steel Foundry Standards

The report of the A. F. A. committee on steel foundry standards, dealing with specifications for standard sleeves, special sleeves and graphite ladle stopper heads, was read by Mr. Janssen, chairman of the committee. The complete report appears elsewhere in this issue of THE FOUNDRY.

The proposed standards elicited favorable comment from R. A. Bull, Duquesne Steel Foundry Co., Pittsburgh; C. H. Gale, Pressed Steel Car Co. McKees Rocks, Pa.; and J. Lloyd Uhler, Union Steel Casting Co., Pittsburgh. The report of the committee was unanimously accepted and the proposed standards adopted.

R. A. Bull read a paper entitled "Molding and Casting Large Slag Pots", written by C. J. McMahon, Illinois Steel Co., Chicago. An article describing the methods employed in molding these large slag pots will appear in an early issue of THE FOUNDRY.

Considerable interest was shown in the presentation and discussion of papers dealing with electric furnace design and operation. W. A. Janssen, Canadian Steel Foundries, Ltd., Montreal, Que., presided. C. R. Messinger, Sivyer Steel Casting Co., Milwaukee, read a paper comparing the electric furnace and steel converter in the manufacture of small steel castings.

Ralph H. West, West Steel Casting Co., Cleveland, called attention to the short life of several furnace roofs mentioned in Mr. Messinger's paper. He pointed out that whereas some of the roofs had given service for more than 400 heats, three had failed before 10 heats had been tapped. Mr. Messinger attributed this apparent inconsistency to the fact that the short-lived roofs were in service during the time when new melters were learning how to operate the furnace. The fault, he thought, was not due to the failure of engineers to specify satisfactory

roofs, but to the inexperience of the melters.

W. R. Bean, Naugatuck Malleable Iron Co., Naugatuck, Conn., asked Mr. Messinger to name the principal factors which make 24-hour operation of electric furnaces desirable. In reply, Mr. Messinger stated that continuous operation enables the manufacturer to obtain a low power rate from the central station company, reduces the consumption of refractories, and greatly increases the output of the plant. Anketell Henderson, Commonwealth Steel Co., Sydney, Australia, asked if the water-cooled electrode has proved dangerous. Mr. Messinger replied that in his experience two accidents had occurred, each of which caused injuries to the workmen. He stated that the trouble was caused by burning the bottoms down until steam was generated in the cooling chambers, resulting in violent explosions. These failures, according to Mr. Messinger, should not condemn the furnace, as the accidents were obviously caused by carelessness. Several speakers discussed the problem of electrical surging in the power lines, and it was generally agreed that a central station company can profitably serve only a limited number of manufacturers who operate single-phase furnaces of large capacity. The load on the power plant must be well balanced to assure good servie to power consumers.

Carl H. Booth, Booth-Hall Co., Chicago, read a paper written by Douglas Walker of the same company dealing with recent developments in the application of the electric furnace to the melting problem.

The paper, "Notes on an Electric Furnace Design," by John A. Crowley, John A. Crowley Co., Detroit, was read by A. M. Minnick of the same company.

P. A. E. Armstrong, Ludlum Steel Co., Watervliet, N. Y., stated that the arrangement of the electrodes, their holders, the busbars and flexible cable, has an important bearing upon the efficiency of the furnace. He spoke of difficulties encountered because of sticking and broken electrodes. The trunnion tilting arrangement is unsuited to large furnaces, declared Mr. Armstrong, because it causes the spout to move in such a large arc that the ladle has to be moved toward the furnace to prevent spilling the metal near the end of the tap. He recommended the rocker arm as the best tilting arrangement for large furnaces. Referring to the flow of current through the hearth, Mr. Armstrong claimed that the magnesite bottom must attain a temperature of approximately 500 degrees Fahr. before it will conduct electric current. Mr. Hodson, Electric Furnace Construction Co., London, Eng., later took exception to this statement, claiming that after current has once passed through the hearth, it will flow even when the bottom is cold. Mr. Hodson also differed with Mr. Armstrong on the seriousness of the electrode problem, saying that very little trouble is caused by faulty electrodes. In defending the trunnion tilting arrangement for small furnaces, Mr. Minnick claimed that the unusually small space required for the tilting mechanism is a marked advantage.

C. F. Hirshfeld, Edison Illuminating Co., Detroit, read a paper entitled "The Electric Furnace from the Central Station Standpoint", written by E. L. Crosby, Detroit Edison Co., Detroit. This paper appears in full elsewhere in this issue of THE FOUNDRY.

Malleable Men Discuss Practical Problems

THE constantly growing interest in malleable foundry problems was again attested in the enthusiastic malleable session held Wednesday morning with J. P. Pero, president of the American Foundrymen's association, in the chair. Although covering a wide range of subjects, the discussion centered around the use of pulverized coal in air and annealing furnaces and in the various features of annealing practice.

The following papers were read and discussed: "The Theory of the Modern Waste-Heat Boiler and Possible Application of Such Boilers to the Malleable Melting Furnace," by A. D. Pratt, Babcock & Wilcox Co., New York; "Application of Waste-Heat Boilers to the Malleable Melting Furnace," by C. D. Townsend, Danville Malleable Iron Co., Danville, Ill.; "Application of Pulverized Coal to the Air Furnace," by W. R. Bean, Naugatuck Malleable Iron Works, Naugatuck, Conn.; "Application of Pulverized Coal to Malleable Melting Furnaces," by Joseph Harrington, Chicago; "How Malleable Iron Has Improved," by Enrique Touceda, Albany, N. Y.; "Troubles Encountered in Machining Malleable Iron—Causes and Remedies," by A. T. Jeffery, Dayton Malleable Iron Co., Dayton, O.; "Comparative Carbon Losses in Malleable Iron Annealing by Muffle and Pot Oven Methods," by Joseph B. Deisher, T. H. Symington Co., Rochester, N. Y.; "The Effect of Iron Oxide in Molding Sand," by W. R. Bean, Eastern Malleable Iron Co., Naugatuck, Conn.

Waste-Heat Boilers

The papers on waste-heat boilers by Messrs. Pratt and Townsend were presented by title.

Considerable discussion was created by the presentation of the two papers on pulverized coal by Joseph Harrington and W. R. Bean, respectively.

At the outset, Mr. Harrington states that melting malleable iron with powdered coal must still be considered in the experimental stage. "The assurance that its advocates feel," he continues, "comes from an analysis of the requirements for melting and the definitely defined results that can be obtained with this fuel in securing controllable temperatures." The ease with which the charge can be melted rapidly with powdered coal is pointed out. Flame temperatures in excess of 3000 degrees may be produced with powdered coal. The effect of powdered coal fuel on the furnace lining is discussed, together with its influence on the character of the slag through the introduction of melted ash from the fuel. All the evidence, the author states, points to the fact that with powdered coal there is a decrease in the amount of carbon burned out of the bath to the extent of 2 to 5 per cent.

In spite of its manifest advantages, however, malleable foundrymen are reluctant to take up powdered coal in earnest. "It is certainly a case where precedent is strong," the author concludes, "and the reluctance of foundrymen to take the first step will probably be balanced by their eagerness to fall in line just as soon as the pioneer has completed his work."

Mr. Bean based the need of mechanical firing on the lack of uniformity in hand firing. Mechanical stokers have not yet solved the problem, while the use of pulverized coal gives promise of success. Mr. Bean describes and discusses the results of tests covering 36 heats in an air furnace using pulverized coal. Coal whose ash has a low fusing point has an advantage over that in which the fusing point of the ash is high. Pulverized coal fires are easily started, and with reasonable care, no difficulty should be experienced from smoke or coking. It is suggested that pulverized coal furnaces offer an opportunity for the employment of waste-heat boilers and admit the possibility of using silica brick in furnace linings. The advantages derived from pulverized coal firing are elimination of exhaustive labor, the solution of the clinker problem, a reduction in the cost of fuel, the elimination of smoke, a more advantageous use of waste-heat boilers, and a reduction in the cost of furnace maintenance. Tabulated results of tests are given.

Stanley G. Flagg III, Stanley G. Flagg & Co., Philadelphia, recommended mechanical firing but said he believed oil is more easily adapted to the air furnace than pulverized coal. In reply, Mr. Bean said open-hearth furnace experience has shown that pulverized coal is preferable to oil even at 2 cents a gallon. He said he believed oxidation is more difficult to control with oil than in the case of hand-fired coal furnaces and that it is difficult to reach high enough temperatures. President Pero countered with an enthusiastic recommendation of fuel oil for air-furnace use based on favorable experiments at the plant of the Missouri Malleable Iron Co. Hand firing, said Mr. Pero, is doomed. Mr. Bean said the relative cost of coal and oil depends entirely on the respective heat values and unit prices of the two fuels in given localities, concluding with the statement that in his judgment the furnace is more easily controlled with pulverized coal than with oil.

Mr. Flagg asked if the dust from powdered coal installations is offensive to the neighborhood where the furnaces are installed. Mr. Bean pointed out that very little dust can pass the melting zone. About 1600 pounds of ash are formed in melting down a 20-ton heat. The use of a combustion chamber helps to control the dust nuisance which is less tractable in the annealing furnace than in the air furnace. Referring to Mr. Harrington's paper, Mr. Bean said he doubted if a temperature of 3000 degrees can be reached with powdered coal, the maximum range being nearer 2800 degrees, with a temperature of 2500 degrees at the stack base.

How Malleable Has Improved

In his paper on the improvement of malleable iron Mr. Touceda presents in tabular form the results of thousands of malleable iron test bars produced by a number of different founders during 1915, 1916 and 1917. The figures show a steady improvement in the quality of the metal. In addition, data from individual shops are given to show that uniformly good results are being obtained, and in the opinion of the author, uniformity of product is more important than high tensile strength. The figures covering bars tested in 1915, 1916 and 1917 show that in 1915 the proportion of bars that failed to test up to 40 000 pounds was 5.80 per cent; in 1917 it had dropped to 1.68 per cent. Only 2.40 per cent of the bars exceeded 5200 pounds in 1915; in 1917 18.49 showed better than this figure. The author believes the test data presented show that, provided the casting is sound, high quality malleable iron can be produced today just as easily in sections around 1¼-inch thick as in the case of the ⅝-inch sections. A. T. Jeffery's paper on machining malleable iron is published in full elsewhere in this issue. Stanley G. Flagg III pointed out that all complaints from the machine shop should be carefully investigated. Many foundrymen, he stated, are too easygoing in this particular. Therefore they are imposed upon and replace returned castings, the acceptance of which should be insisted upon.

In a similar complaint, C. H. Gale, Pressed Steel Car Co., McKees Rocks, Pa., pointed out that in many cases customers say castings are too hard when as a matter of fact they are in reality too soft and tough. E. H. Wood asked what is the ultimate machining speed of malleable iron. Prof. Touceda replied that malleable can be machined at brass speed, that is about 150 feet per minute.

Pot vs. Muffle Annealing

The paper presented by Joseph B. Deisher on carbon losses in annealing deals with the various factors entering into the heat treatment of malleable castings in muffle and pot ovens. According to the author the safe annealing temperatures are from 1450 to 1650 degrees Fahr. for pot ovens and from 1500 to 1700 degrees for muffle ovens. Mr. Deisher believes that the 60 hours usually considered necessary to completely dissolve the iron carbide are not actually required and that the best practice is to bring the castings to the highest temperature at the beginning of the anneal, such temperature to be held until the iron carbide is dissolved, and then drop to 1400 degrees, which is considered favorable for the precipitation of the graphitic carbon. In a comprehensive discussion of the advantages and disadvantages of the pot and muffle ovens, the author concludes that the conversion rather than the removal of carbon in the anneal produces ductility. This contention seems to be borne out by the results of tests made with castings which were annealed in mild packing, strong packing and without packing of any kind.

L. W. Marcus, metallurgist, Rhode Island Malleable Iron Co., opened the discussion by pointing out that the time required for the disassociation of carbon is fixed but that the time consumed in getting up to proper temperature may be controlled within certain limits. Annealing time could be cut down, he said, if the furnace temperature could be more readily controlled at the critical range. Enrique Touceda recommended very slow cooling during the incipient stages of the anneal. He suggested seven to eight degrees per hour for the first 15 hours and not over 10 degrees per hour for the next 15 hours. The cooling down to the critical point, 1250 degrees, he said, should be as slow as possible. Below 1200 degrees, Mr. Deisher said, the castings "could be cooled in ice water".

C. H. Gale said the carbon loss in annealing in his experience is invariably around 1 per cent, instead of from 0.35 to 0.65 per cent, as stated by Mr. Deisher. A. L. Pollard, Johnston Harvester Co., Batavia, N. Y., confirmed Mr. Gale's figures. The carbon loss can be reduced, he said, by packing in an inert material such as sand.

In his paper on iron oxide in molding sand, W. R. Bean declares that the presence of oxide is detrimental to good surface finish of castings. This conclusion is based on three experiences of the author with sand containing the oxide. When dust taken from a dust arrester was added to the molding sand, the metal washed away the sand in the parts of the mold surface. Sand analyzing 5 per cent iron oxide became so hard in pockets of the castings that it could not be removed in cleaning. In a third instance the addition of sand containing iron oxide formed a lumpy mixture which could not be reduced to the proper degree of fineness for use as molding sand. According to the author, the best surface finish is obtained by using a facing of new fine molding sand put through a mixer without the addition of sea coal facing or any other element. Nature seems to blend the silica and alumina, the principal elements in molding sand better than we can do it by mechanical means.

Stanley G. Flagg III confirmed Mr. Bean's conclusions regarding the advisability of dispensing with facings in molds for small castings. In addition, he said the sand should be as dry as possible. R. W. E. Hayes, Hayes Pump & Planter Co., Galva, Ill., said his experience agreed with Mr. Bean's.

Borchers electric furnace consists of an iron casing with a refractory lining and a bottom containing a water-cooled steel block which is connected to one pole, while the other connects with a vertical, movable electrode. The furnace has a tap hole.

The Dunham Co., Berea, O., has moved its general offices to 801-4 Hippodrome building, Cleveland. This company manufactures rollers and pulverizers, and also turns out gray iron castings for automobile manufacturers. The factory and foundry will remain at Berea.

Major Henry Souther, formerly vice president of the Ferro Machine & Foundry Co., Cleveland, died at Fort Monroe hospital Aug. 22 at the age of 52 years. He was recently commissioned a major in the army and appointed an officer in charge of the Langley aviation field.

Institute of Metals Puts in a Busy Week

Papers Dealing With Wide Range of Subjects Read and Discussed —Special Session on Use of Nonferrous Metals for Munitions

THE annual meeting of the American Institute of Metals held at Boston, Sept. 24 to 28 concurrently with the convention of the American Foundrymen's association was replete with interesting discussions of both foundry and metallurgical problems. The opening session was held jointly with the American Foundrymen's association in the Mechanics building on Monday afternoon, Sept. 24. The details of this session are covered in the report of the proceedings of the American Foundrymen's association elsewhere in this issue.

President's Address

Jesse L. Jones, Westinghouse Electric & Mfg. Co., Pittsburgh, president of the American Institute of Metals, presented his annual address at the joint meeting. In part, this address is as follows:

"The period that has elapsed since the beginning of the war has been marked by great progress in nonferrous technology. Under the spur of necessity, many articles previously imported had to be made in our own country because they could no longer be obtained abroad. New problems also arose constantly in connection with the manufacture of munitions.

"Foremost I may mention the commercial production of electrolytic zinc. Previous to the war the market for high-grade zinc was rather narrow. With the placing of munitions contracts which called for brass with less than 0.1 per cent lead, the demand was greatly augmented and the price mounted rapidly as the firms making high-grade zinc by distillation processes did not have enough capacity to supply the unusual market. This resulted in a number of firms engaging in the manufacture of electrolytic zinc, it even being found profitable to cast anodes from prime western spelter and electrolytically refine them. In some cases a purity of 99.98 per cent has been obtained. It will be interesting to users to see whether the electrolytic zinc is able to compete in purity, uniformity and price with the high-grade distilled zinc. If the two processes give equally good results there should be a broader market for high-grade zinc after the war when prices are lower and supplies abundant. The thin, tough coating that this grade of zinc gives, warrants its extensive use in hot galvanizing. It can also be used advantageously in high-grade manganese bronze, aluminum alloys, sheet brass and die cast alloys.

"Instead of the production of electrolytic zinc cathode sheets, the product can be converted into zinc dust. As this zinc dust is very pure it opens the way for improvements in the sherardizing process, it being recognized that the purer the zinc coating on an iron or steel article, the better it will be protected from corrosion.

Large Slime Accumulations

"The production of electrolytic zinc has resulted in the accumulation of large amounts of slimes or residues high in cadmium. Electrolytic cadmium has been produced experimentally from these slimes and I would suggest active research work in developing new uses on a large scale for metallic cadmium.

W. M. CORSE
After Effective Service as Secretary Elevated to the Presidency of the American Institute of Metals

"Quite recently the production of electrolytic tin has been announced. The difficulty of obtaining Straits tin makes the advent of the electrolytic tin doubly welcome. In the electrical industry, in particular, extremely pure tin is essential as the connectors of electrical apparatus require the use of the highest grades of tin obtainable.

"The demand for alloys for aeroplane work has brought magnesium into prominence. This metal which came entirely from abroad, can now be had in any desired amount from American makers. The extreme lightness of its alloys with aluminum, the high speed at which they can be machined and their relative cheapness bulk for bulk should result in a constantly increasing demand for magnesium.

"The scarcity and high price of antimony has led to the development of a novelty in the shape of electrolytic babbitt. This contains no antimony or tin necessarily but consists of lead hardened by small amounts of the alkaline earth metals, barium, calcium, etc.

"The crucible makers of the United States have been handicapped by inability to obtain the Ceylon graphite and Klingenberg clay they formerly used. With characteristic American energy and ingenuity, however, they have already so adapted the clays and graphite which are available that very fair results are being obtained except possibly on the larger sizes of crucibles. The high price of crucibles has led to the rapid adoption of electric furnaces for melting nonferrous metals. Both carbon resistor and induction types of furnaces seem to be doing satisfactory work in melting brass for rolling into sheets for cartridge cases, etc. For foundry work where light castings are run and hot metal required not so much progress has been made.

"This list of nonferrous achievements could be much extended but I will mention only one thing more. Recently, when the demand for copper driving bands was so urgent that the tube mills could not meet it, a number of foundries succeeded in producing very satisfactory copper castings for this purpose. When rolled into bands, physical characteristics equal to those found in the drawn tubes were obtainable. In the opinion of many ordnance experts these bands because they are rolled radially are superior to those cut from tubes which are drawn lengthwise. The greatest care is required in order to obtain copper castings that will be sound and clean."

The first professional session of the American Institute of Metals was held at the Hotel Somerset at 9:30 a. m., Tuesday, Sept. 25, with President Jones in the chair. The initial paper was entitled "Raw Materials Used for Crucibles", by Prof. A. V. Bleininger, United States bureau of standards, Washington, D. C. This paper, which was read in abstract in the absence of the author, deals with the manufacture of crucibles from the selection of the raw materials to the completion of the annealing of the finished article. The raw materials are graphite, sand and fire clay. The specific gravity and various other properties of graphites are given. Crucible making is so old an art that it is difficult to present anything new concerning it; consequently, while Prof. Bleininger evolved a very interesting paper, many of those present during its presentation were fairly familiar with the facts brought out.

In the discussion that ensued, M. McNaughton, Joseph Dixon Crucible

Co., Jersey City, N. J., said crucibles cannot be improved in density by exposure to high temperatures. Jesse L. Jones, Westinghouse Electric & Mfg. Co., East Pittsburgh, mentioned the fact that the larger a crucible, the poorer it is likely to be, and George C. Stone, New Jersey Zinc Co., Palmerton, Pa., gave an explanation of this peculiarity by citing some of the difficulties he had encountered and the precautions he had found it necessary to take to obtain good results in making zinc retorts. In making these retorts, which are of similar raw materials to crucibles, it is imperative that the material be graded to certain sizes depending upon whether a large or small retort is to be made. Possibly, he said, crucible makers may be using a uniform size of raw material for both large and small crucibles. The large crucibles fail and the small ones do not, due to the fact that while the grain size of the raw material is suitable for the small crucible it is not adapted for larger ones.

He also emphasized the importance of slowly drying the green crucibles or retorts. The drying should extend over a period of months, and when properly accomplished tests have shown that the tensile strength of the crucible material is double that obtained when the vessels are too rapidly dried, and when the grain size of the raw materials is not uniform and adapted to the particular size of the retort.

Melting Bars in Electric Furnace

A paper was presented by G. H. Clamer, Ajax Metal Co., Philadelphia, entitled "Melting Yellow Brass in New Form of Induction Furnace". No one kind of electric furnace, remarked Mr. Clamer, is suitable for melting all the different alloys and the particular furnace he described which is known as the Ajax-Wyatt induction furnace is at its best when melting yellow brass, manganese-bronze, muntz metal, and similar high-zinc alloys. He then outlined some of the conditions under which induction furnaces are operated and the difficulties to be guarded against including the "pinch effect" and low power factor. Diagrams were shown illustrative of single-phase type, horizontal-plane, induction furnaces. The first closed type of induction furnace was invented by Charles P. Snyder, Creusot, France, and several diagrams were shown to illustrate the principle on which this furnace worked.

A very interesting paper was read by W. H. Parry, National Meter Co., Brooklyn, N. Y. This paper was on "My Experience with Metal Melting Furnaces", and described some of the troubles encountered during the installation and initial operation of a furnace for melting reclaimed brass foundry wastes. These difficulties were largely due to the lack of available data concerning such furnaces. Practical experience had shown that the material before melting should be thoroughly cleansed of all gangue, which is accomplished by crushing, washing, concentrating and drying, then again washing to float off all emery dust. The clean material is separated into fine and coarse, and the charge consists of one-third fine and two-thirds coarse material. Iron is removed by a separator, and experience has shown this is best effected by working the material in a thin layer no deeper than the size of the chips. In the opinion of the author, skillful manipulation is the most necessary factor in the situation.

A paper on "Shrapnel Bullets", was presented by Harold J. Roast, James Robertson Co., Ltd., Montreal, Que. The alloy used for shrapnel bullets consists of 12.5 per cent antimony and 87.5 per cent lead. Segregation of the antimony was found a source of difficulty which was finally overcome by a constant and thorough stirring of the metal bath and by casting in water-cooled molds. The discussion brought out several suggestions for avoiding segregation, one being to add the antimony in a powdered form to the molten lead, and another being to melt the lead and antimony separately, one in a kettle, the other in a crucible, and pour the liqid metals together.

An interesting method of making tin babbitts was described by Charles Pack, Doehler Die Casting Co., Brooklyn, N. Y. This consists in first melting the tin, covering with a flux of zinc chloride and introducing the copper or antimony or both through the flux which caused them to become tin coated, and by thus preventing oxidation, made them easily soluble in the tin. The variation of analysis by this method was 0.2 per cent antimony.

"Recent Industrial Uses of Aluminum" were discussed by F. G. Shull, Aluminum Co. of America, Boston. Mr. Shull gave a list of the more modern uses that have developed for aluminum, comprising aluminum foil, aluminum bottle caps, autogenous welding operations, die and pressed castings, pneumatic tubing for intercommunication in stores, rolled rod for machining purposes and aluminum conductors, steel reinforced.

Two papers were withdrawn from the program of this session. They were "The Use of Die Castings in Munitions", by Charles Pack, Doehler Die Casting Co., Brooklyn, N. Y., which could not be presented owing to an embargo on this information placed by the war department, and the paper on "The Consumption of Copper and Its Varied Uses", by H. D. Hawks, United Metals Selling Co., New York.

The secretary-treasurer's report shows that the institute on July 1, 1917, had 282 active and 64 associate members, making a total of 346. In the active membership are included the corporation memberships, rated as three active members each. The most important feature of the current year has been the adoption of the plan to issue a quarterly journal of the annual volume of transactions. The secretary's report also states that many members of the institute have been called upon by the government to serve in various capacities of a technical nature.

The first paper presented at the Thursday session of the American Institute of Metals was, "Comparative

New Officers A. I. M.

President
W. M. Corse
Titanium Alloy Mfg. Co.,
Niagara Falls, N. Y.

Secretary-Treasurer
Fred L. Wolf
Ohio Brass Co.,
Mansfield, O.

Senior Vice President
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Harold J. Roast
The James Robertson Co., Ltd.,
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William A. Cowan
National Lead Co.,
Brooklyn, N. Y.
H. S. Gulick
Morse-Jones Brass & Metal Co.,
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C. W. Johnson
Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.
H. Wentworth
American Zinc & Lead Co.,
New York
A. L. Antisell
Raritan Copper Works,
Perth Amboy, N. J.
G. M. Fritch
American Brass Co.,
Kenosha, Wis.

Tests on Test Bars and Actual Castings," by W. M. Corse, Titanium Alloy Mfg. Co., Niagara Falls, N. Y. The method adopted in making the test bar and of obtaining it from the casting is described in the paper. The separately cast test bars were run with a fin-gate which permitted a maximum feeding effect, and the test bars from the castings with which they are compared were cut directly from the castings, and in some cases were in the form of thin, flat strips. The object in presenting these tests is to direct the attention of the designing engineer to the fact that the average of a number of physical tests should not be used to originate minimum specifications for physical properties of alloys. These average results would be much higher than could possibly be obtained from castings made in the ordinary manner. Owing to the structural design of the latter it was seldom possible to feed metal to supply the intercrystalline shrinkage, to the same extent as in the case of the separately cast test bars, consequently specifications formulated in the manner outlined were only met by manufacturers with great difficulty and at the expense of many failures.

Speeding Up Analyses

The second paper, entitled "Analyses of Brass, Bronze and Babbitt", was read in abstract in the absence of the author, E. W. Hagmier, Superior Rubber Co., Inc., Buffalo.

The paper on "The Flux and Cleaner Question of Brass", by E. D. Frohman, S. Obermayer Co., Pittsburgh, was read by proxy. The various substances that are commonly used as fluxes for brass are reviewed and the fact is brought out that it is the aim of the manufacturers of the special flux to create an atmosphere of carbon monoxide gas in contact with the molten metal which it is contended would reduce some of the oxides to the metallic form. Instances of successful operation of the flux are cited.

In the discussion, the opinion was expressed that the province of a flux as such is limited to use in the case of metals contaminated with non-metallic matter with which the flux can unite to form a fluid slag which automatically arises to the surface of the metal, thus freeing the latter from its combination. President Jones had found the flux in question useful, but analysis showed it to consist of fine coke dust mixed with clay. It was brought out that an efficient cover for molten brass is salt mixed with plaster of paris, especially in the case of open-flame melting furnaces. Tests on ingot from sheet copper melted in contact with a salt and plaster flux had shown the cuprous oxide was reduced, being less in the ingot than the sheet. A question arose as to the chemical action of the salt, and the hypothesis was advanced and accepted that the deoxidizing effect was due to the reduction from the salt of nascent sodium by the high temperature of the furnace and the action of the carbon present.

G. H. Clamer, Ajax Metal Co., Philadelphia, thought that too much attention was given to oxygen and not enough to the sulphur present and others agreed with this view. As a result of this discussion Mr. Clamer suggested that a committee be appointed by the institute to investigate the merits of fluxes so that a recommendation of a dependable one could be made. Although the suggestion was not a motion, it was seconded by C. P. Karr, bureau of standards, Washington. The suggestion was referred to the executive committee for action.

Development of Pyrometers

"Pyrometers — Their Construction and Application," by John P. Goheen, Brown Instrument Co., Philadelphia, was the next paper read. The author touches on the early history of the pyrometer, stating that the first pyrometer made in the United States was of the expansion type and was produced in 1860. This pyrometer measured up to 900 degrees Cent. The difference between the single suspension types and the double pivoted types of pyrometers is shown and the general improvements lately made are discussed. The discussion brought out the fact that no entirely satisfactory protecting tube for the thermo-couple is known.

The next paper presented was entitled "Electrically Heated Core Ovens", by Dr. C. F. Hirshfeld, Edison Illuminating Co., Detroit. This was followed by a paper on "Brass Foundry Core Practice", by H. M. Lane, Detroit. A uniform size of grain should be aimed at in selecting sands for cores as this gives maximum venting properties.

Final Session

The concluding session of the American Institute of Metals was opened with the senior vice president, George C. Stone, New Jersey Zinc Co., New York, in the chair in the absence of President Jones. The first paper on the program, which was read by title, was "The Electrolytic Production of Antimony," by Prof. D. J. Demarest, Ohio State University, Columbus, O.

The second paper, "The Electrical Properties of Some High Resistance Alloys", by Prof. M. A. Hunter, Rensselaer Polytechnic Institute, and F. M. Lebast, Troy, N. Y., was read in abstract by Prof. Hunter. In the discussion that followed it developed that chromium and copper form what might be termed a metallic emulsion and that the union of chromium and copper is analagous to the union of oil and water when emulsified, instead of being a true alloy. These admixtures, however, do not segregate, tests have shown, up to a content of 20 per cent chromium.

A paper entitled "The Amorphous Theory in Metals", by Zay Jeffries, Aluminum Castings Co., Cleveland, O., followed. It was a highly technical, but very interesting paper, which, on account of its length, will be reserved for a future issue of THE FOUNDRY. The thanks of the meeting were extended to Prof. Jeffries for his valuable contribution to the literature of the brass metallurgist.

The paper on "The Volatility of Zinc and Cadmium", by John Johnston and Edward Schramm, American Zinc, Lead & Smelting Co., St. Louis, was withdrawn, and the papers entitled "Surface Tension and Deoxidizing of Metals", by W. J. Knox, Metals Deoxidizing and Refining Co., New York, and "Antimony—Its Metallurgy and Uses", by K. C. Li, Wah Chang Mining & Smelting Co., Inc., New York, were read by title.

"The Development and Reabsorption of the Beta Constituent in Alloys which are normally of the Alpha Type", by Prof. C. H. Mathewson, department of mining and metallurgy, Yale University, and Philip Davidson, New Haven, Conn., was read in abstract. The thanks of the meeting were extended to Prof. Mathewson for his paper.

The last paper on the program, entitled the "Swelling of Zinc Base Die Castings", by H. M. Williams, National Cash Register Co., Dayton, O., was read by title.

Shorter Sessions Next Year?

Secretary Corse announced that at the request of the executive committee he would ask for an expression of opinion from the members as to the advisability of curtailing the length of the sessions at the next meeting.

W. H. Bassett thought the present sessions had been very skilfully arranged with the intention of holding the interest of the members to the last. He felt, however, that the time required for the sessions could be materially shortened and suggested holding evening sessions.

Exhibits at Boston Reflect War's Influence

Display of Foundry Equipment Reveals Greater Interest in Labor Saving Devices, Standardization, and Problems of Munition Manufacture

THE reaction of American industry to war conditions was clearly evident in the twelfth annual foundry and machine exhibition at Boston, Sept. 24 to 28. The show was larger than ever, the exhibits more varied in character and every manufacturer evidently had made a special effort to display equipment and products of special value in the present emergency.

Not only was the show the largest of its kind, but the attendance far surpassed previous efforts. It is estimated over 2500 persons passed through the entrances during the week. The two vast floors of the great Mechanics' pavilion were crowded with exhibits. As the accompanying illustrations indicate, the show was unusually well arranged and beautifully decorated. Well lighted rooms and high arched ceilings contributed materially to an attractive general effect.

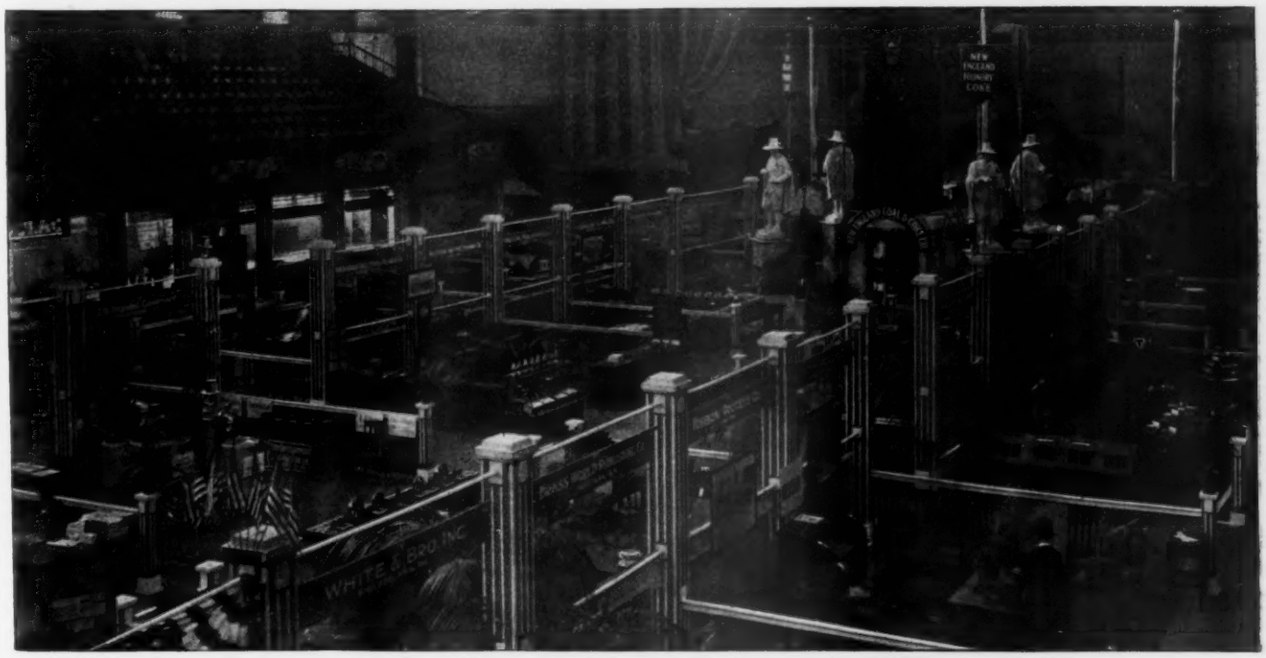
A large number of army and navy officers attended the show. It was evident from their interested inquiries and frequent conferences with plant experts that the industrial and military forces of the country are being thoroughly co-ordinated to win the war.

As at several previous exhibitions, molding machines and sand-blast apparatus held the center of the stage. Over 60 molding machines and 15 sand-blasting outfits were in operation throughout the week. The very latest types, of course, were displayed for inspection. In fact, the annual recurring foundry and machine exhibitions afford an excellent opportunity to make both quantitative and qualitative analyses of the year's progress in the manufacture of foundry and shop appliances of all kinds. Furthermore, if the shows offered no further advantages, they would be well worth while, for it has long since been demonstrated in the foundry industry that the rate of progress is dependent almost directly on the effectiveness of the available facilities for the interchange of information. The molding machine manufacturers particularly appreciate the opportunity once a year to meet not only their customers, but their competitors.

ARTISTIC EXHIBIT, NEW ENGLAND COAL & COKE CO.

A survey of the exhibits at the Boston show leads easily to the conclusion that molding machines are now thoroughly standardized. Radical innovations are the exception rather than the rule. Improvements consist in refinements of detail, and as in the case of the much-heralded Liberty aeroplane motor, in new combinations of thoroughly tested elements. Not over three radically new molding machines were exhibited, but the minor improvements and refinements evident on practically every machine prove conclusively that manufacturers have not been idle during the past 12 months.

At the present stage of the development of the molding-machine business,



GENERAL VIEW OF FOUNDRY EXHIBIT LOOKING WEST IN GRAND HALL

attention is being centered on precision in manufacture and improvements designed to still further reduce the manual efforts of the molder. Owing to the widespread shortage of labor, now being augmented by the operation of the selective service law, the demand for machines that will save human effort on the molding floor is more insistent than ever. Furthermore, molders are constantly becoming more captious, and in some sections of the country even arrogant, with the result that foundrymen see more keenly than usual the necessity for machines designed not only to replace men, but to reduce to a minimum the demands on the muscles and intelligence of the relatively few operators that may be required. Molding-machine manufacturers are fully awake to this situation and they are co-operating with the foundrymen with characteristic energy. The latest machines, such as those displayed on both floors of the great Mechanics building at Boston, perform all of the operations connected with making a mold, some of them even being provided with auxiliary apparatus for filling the mold with sand and for carrying away the completed flasks. In many cases, the workman is called upon to do nothing more fatiguing than operating an air valve or electric switch. In superiority of finish and precision in the manufacture of its working parts, the molding machine of 1917 forms a striking contrast with its predecessor of 1907. Today many molding machines are machine tools in the fullest sense of the word: their parts are as accurately made and carefully fitted as those of a fine lathe or milling machine. In many cases, the moving parts run in an oil bath and the design is such that no sand can find its way into the bearings or between fitted surfaces. It is such refinements as these that make it possible to use molding machines for the production of high-power, complicated, multi-cored automobile and aeroplane cylinder blocks with metal sections pared to 5/32-inch. In fact, in such cases the machines turn out work that the most skilled hand-molders cannot duplicate. In spite of these improvements, molding machines are relatively cheaper at the present time than they were in the neighborhood of 10 years ago.

GENERAL VIEW OF GRAND HALL, MECHANICS BUILDING DURING THE TWELFTH ANNUAL FOUNDRY AND MACHINE EXHIBITION

A Simplified Roll-Over Machine

An unusually interesting machine of a new type was displayed by the American Molding Machine Co., Terre Haute, Ind. This machine, which was shown in operation, was designed by W. C. Norcross. It is of the combination roll-over, jolt type, pneumatically operated. Instead of employing separate units, however, the roll-over and ramming functions are controlled by a single air cylinder. When jolting the mold, this cylinder operates in the usual manner. For the roll-over operation, a unique link-motion and an automatic latch are brought into play. The mold is balanced at the center and virtually no force is required to roll it over. An oil-filled balancing cylinder is provided to steady the roll-over operation. The flask is turned onto an automatic ball-and-socket leveling device that is self compensating for any irregularities in the flask or mold. The machine exhibited was provided with a 30 x 40-inch table and a cylinder 10 inches in diameter.

The American Molding Machine Co. also exhibited a combination jolt-stripping plate machine with a 24 x 36-inch table and a 12-inch draw. One cylinder jolts the flask and draws the pattern. The stripping operation is performed by first raising the flask to the full height of the draw, in which position it is held by four steel rods. The pattern is then drawn through the stripping-plate by exhausting the air slowly from the cylinder. The four rods that hold up the flask and stripping-plate are supported by spring-actuated dogs which automatically engage slots milled in the lower ends of the rods

The new Morrison electric jolt-ma-

chine was exhibited by The E. J. Woodison Co., Detroit. This machine has a number of features which tend to make it easy for a relatively ignorant or inexperienced handyman to operate it. It is claimed in particular that it is virtually impossible for the operator to ram the mold either too hard or too soft. This is accomplished by providing the machine with a dial that registers the number of blows; every flask therefore can be correctly rammed. The machine is driven by a motor placed on a column. The jolt, which is produced by a cam-wheel mechanism, is controlled by a hand lever on the side of the machine. The roll-over feature is operated by a crane arm provided with a cable, one end of which is wound around a drum on the cam-wheel shaft. The jolt is received on four steel anvils. The pattern is drawn by means of a socket wrench fitted on the end of a shaft. This is accomplished after the flask is rolled-over; therefore, no leveling device is necessary. The machine exhibited will take flasks up to 20½ x 40 inches. A 12-inch pattern draw is provided.

Mold with 800 Pounds of Cores

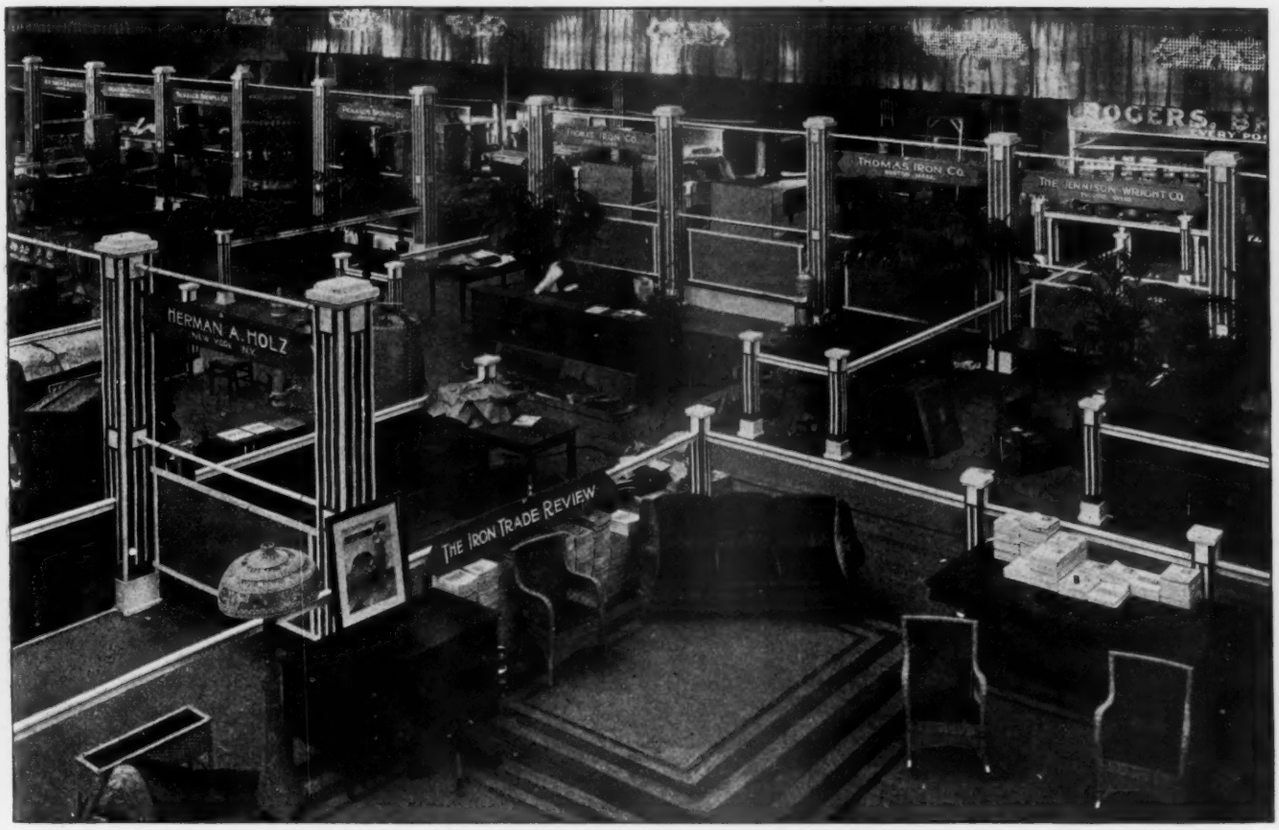
The central feature of the exhibit of the Osborn Mfg. Co., Cleveland, was a 260-horsepower 6-cylinder aircraft-motor casting made on an Osborn jolt-ramming machine. This casting is one of a lot manufactured by Allyne-Ryan Foundry Co., Cleveland, for the Kessler Motor Co., Detroit. It is an excellent example of the possibilities of the modern molding machine. The metal sections in some places are less than 3/16-inch and each mold contains 800 pounds of cores. The Osborn company also exhibited a combination stripping-plate squeezer machine, and a number of plain, pneumatic jolt-ramming machines, together with other examples of its labor-saving molding devices. The well-known molding machines manufactured by Henry E. Pridmore, Chicago, were shown in operation. In the past year a number of refinements and improvements have been introduced, for the purpose of making the machines easier to operate and more accurate in action. A new 20 x 24-inch combination jolt-stripping-plate machine, with electric jolt and pneumatic stripping action was shown in operation making molds for Ford rear-axle housings. A 36-inch combination air-electric rock-over jolt machine was displayed, together with a 24-inch plain pneumatic rock-over drop machine of the type originated by the late Henry E. Pridmore. The visitors during the week displayed considerable interest in an aluminum model of a Pridmore electric jolt-ramming machine. The model was sectionalized so the functions of the various working parts were clearly visible. A number of fine, intricate gray-iron castings made on Pridmore machines also were exhibited. These castings were remarkable for the precision with which they were molded and the excellence of the finish.

Displays Electric Molding Machine

As usual, a complete exhibit was presented by the Arcade Mfg. Co., Freeport, Ill. A new 24-inch electrically-operated, roll-over, jolt-ramming and pattern-drawing machine was one of the features of the exhibit. Two sizes of plain jolt-ramming machines also were displayed; one was fitted with a ferrule plate. The exhibit also included a combination jolt-ramming squeezer machine, air and hand squeezers, piston molding machines, midget core jar-ramming machines and the Brillion pouring device.

An air squeezer equipped with a pneumatic vibrator and a lifting device was prominent in the exhibit of the Berkshire Mfg. Co., Cleveland. In addition, a complete line of wood, iron and aluminum flasks and specially designed aluminum matchplates was displayed. The match-plates are made of a special metal and where extreme accuracy is desired their use is recommended.

The B. & B. Mfg. Co., Indianapolis, exhibited power and hand squeezers. Both portable and stationary machines



THE BOSTON EXHIBIT WAS NOTABLE FOR ITS ARTISTIC AND TASTEFUL DECORATIONS

were displayed. Several sizes and styles were shown.

Machines Without Valves

Jolt-ramming machines without valves were displayed by the Federal Foundry Supply Co., Cleveland. The exhibit included six different sizes of machines. In the operation of these machines, the opening of the exhaust automatically shuts off the intake; the expansive force of the air then forces the piston the remainder of its stroke, fully opening the exhaust. As soon as the pressure is released, the piston drops to its starting point. Six different types of power squeezers and combination jolt-squeezer machines also were shown. The squeezers are provided with extra long cylinders and heavy leather pistons which assist in the conservation of air. One of the combination jolt-ram-squeezer machines had a 4-inch jolting cylinder and a 9-inch squeezing cylinder; the other was equipped with a 5-inch jolting and a 12-inch squeezing cylinder. The plain power squeezers displayed had cylinders 9 and 12 inches in diameter respectively.

Standard plain jar-ramming and combination jar-ramming and squeezing machines were displayed by the Herman Pneumatic Machine Co., Pittsburgh. These machines were not in operation. In addition, the Herman company furnished its booth in a comfortable manner for the entertainment of its customers and visitors.

Specimens of the complete line of molding machines which it manufactures were exhibited by the International Molding Machine Co., Chicago. This exhibit included electric and pneumatic jar-ramming molding machines, plain squeezers, combination jolt-squeezers and the stripping-squeezers, together with hand turn-over draw, power turn-over draw and combination jar-ramming turn-over draw machines. In designing these machines an effort has been made to provide ample reserve strength, together with simplicity of adjustment and accuracy of operation.

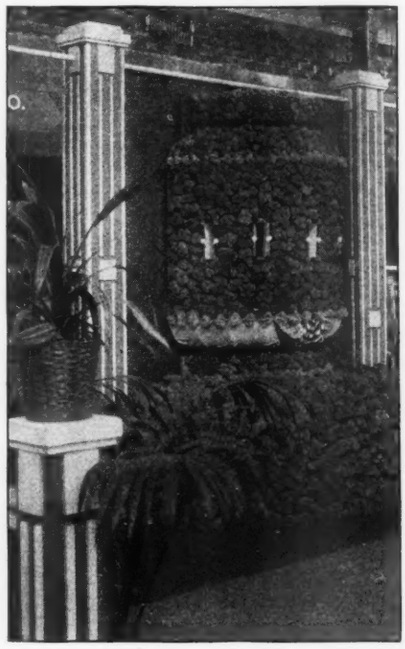
A Machine for Women

A small jar-ramming roll-over machine suitable for core-room operation by women was one of the features of the exhibit of the Midland Machine Co., Detroit. This machine can be operated with a minimum of manual exertion, and at the same time cores of uniform quality can be turned out rapidly. Other types of Grimes roll-over molding machines also were displayed, and interesting motion pictures of molding-machine operations were shown.

As at previous exhibitions, the Mumford Molding Machine Co., Chicago, displayed large-scale sectional drawings of its latest type machine which is equipped with a valve action specially designed to produce a maximum ramming effect with a minimum of air consumption.

Swing-head squeezers of the characteristic type invented by William Nicholls were exhibited in operation by Wm. H. Nicholls Co., Brooklyn, N. Y. Two combination jolt-ramming squeezer machines with an automatic gravity pattern drawing device were also displayed by the Nicholls company. Richey, Browne & Donald, Maspeth, N. Y., exhibited their roller-ramming machine which is suitable for certain classes of work.

Swing-head machines of the plain squeeze and combination types were dis-



HUB OF COKE IN PICKANDS-BROWN EXHIBIT

played by the U. S. Molding Machine Co., Cleveland. The thrust of the squeeze is absorbed by a heavy T-section casting which is stayed on one end by a forged rod. Six different types of machines were displayed.

The E. H. Mumford Co., Elizabeth, N. J., displayed its jolt rock-over draw machine. This machine is designed according to the principles invented by the late E. H. Mumford. An oil-controlled guide plunger is provided, which in combination with an improved starting valve is said to insure a smooth start and a more uniformly accelerated draft.

Further development in automatic sand-blast apparatus was evident in the displays at Boston. Also it is apparent that self-contained sand-blast units are growing in popularity among foundrymen. As a result of legislation and a more enlightened appreciation of the importance of the welfare question, foundrymen today are not content with sand-blast apparatus in which the dust-disposal problem has not been thoroughly worked out. The day has passed, therefore, when sand-blast machinery is purchased piecemeal and operated without attempting to control the dust nuisance.

A 20 x 34-inch gravity-type, positive feed, revolving-barrel sand-blast machine with a capacity of three to five tons of castings a day was displayed by the Brown Specialty Machinery Co., Chicago. In this machine, the sand flows from the main hopper into the auxiliary hoppers and thence to the nozzles by gravity. The air consumption of the machine exhibited is stated to be 75 cubic feet per minute. A larger machine of the same type also is built. It has a 40 x 50-inch barrel, with an air consumption of 300 cubic feet per minute and a rated capacity of 15 to 20 tons of gray-iron or malleable castings a day. The smaller machine is driven by a 2-horsepower motor. The one displayed at Boston has been sold to the government for installation at the Algiers arsenal near New Orleans. The Brown company also displayed its duplex sand sifter and the Hammer core machine.

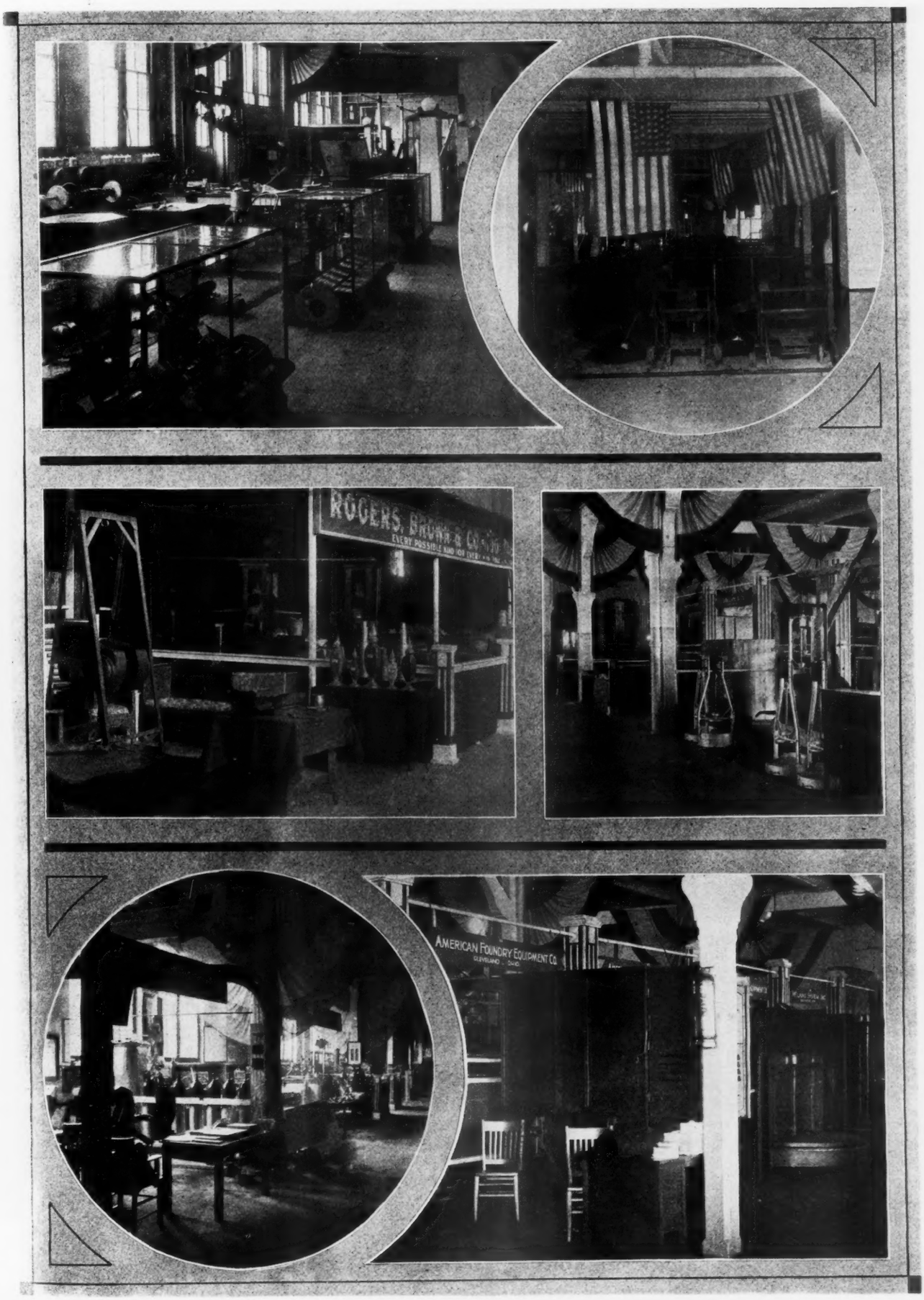
The display of The W. W. Sly Mfg. Co., Cleveland, in the Exhibition Hall, adjoining the Grand Hall, included a complete steel-plate sand-blast room with dust disposal apparatus. This room, which was provided with a closed-hopper sand-blast machine and a grated floor, was approximately 10 x 12 feet in size. A sand-blast barrel with complete dust-handling and sand-renovating auxiliaries also was shown by the Sly company, together with a double unit 6-drawer core oven.

The J. W. Paxson Co., Philadelphia, showed two sizes of its Paxson-Warren sand-blast machine. This machine is designed either for high or low pressure operation. A magnetic separator, a model of a cupola equipped with the Zippler tuyere system and a full line of foundry supplies also were exhibited by the Paxson company.

A sand-blast room of special design in which the operator is said to be practically immune from dust was displayed by the American Foundry Equipment Co., New York. This company also showed several other types of sand-blast machinery, together with its well-known traveling sand-mixing machine.

Improved Rotary Machine

The Hoevel Mfg. Corp., New York, displayed a large sand-blast barrel and an 8-foot rotary table sand-blast machine. These machines were connected to automatic dust-collecting and



THE EXHIBIT COVERED EVERY PHASE OF THE FOUNDRY INDUSTRY

sand-renovating units, making them entirely self-contained. The entire exhibit was operated by a 10-horsepower motor.

A large automatic sand-blast barrel and an automatic sand-blast cabinet machine, with dust-collecting and sand-handling units were exhibited in operation by the Mott Sand Blast Mfg. Co., New York.

The National Engineering Co., Chicago, exhibited a 6-foot sand muller operated by a 10-horsepower motor. This machine has a capacity of from 7 to 10 cubic feet per charge. It is said it will mix up a batch of gray-iron facing sand in three to four minutes and a batch of core sand in two to three minutes. The two cast-iron mullers have chilled rims; the plows also are cast iron with chilled surfaces.

Among other exhibitors of sand-blasting, sand-sifting and sand-handling apparatus were The Pangborn Corporation, Hagerstown, Md.; Blystone Mfg. Co., Cambridge Springs, Pa.; Champion Foundry & Machine Co., Chicago; Great Western Mfg. Co., Leavenworth, Kans.; Harrison Supply Co., Boston; J. A. Macleod Co., Cincinnati; and the New Haven Sand Blast Co., New Haven, Conn.

Foundry and sand-blast sands were exhibited by the Portage Silica Co., Youngstown, O., and the Albany Sand & Supply Co., Albany, N. Y. The latter showed a stove made at the Walker & Pratt foundry, Boston, with Albany sand and the former a full line of supplies of silica sand, sand-blast sand, gravel, etc. Foundry sands also were displayed by several of the large dealers in foundry supplies.

Pneumatic Machinery Attractively Displayed

The growing popularity of pneumatic machinery in foundries and machine shops was evidenced by the unusually complete exhibits of manufacturers of air-operated equipment. The Sullivan Machinery Co., Chicago, operated a 14 x 8¾ x 10-inch angle-compound air compressor. This compressor, which is equipped with improved plate valves and driven by a 75-horsepower General Electric motor, delivered air to the various pneumatic tool exhibits. The capacity of the machine is 445 cubic feet of free air against a terminal when operating at 250 revolutions per minute. An 8 x 8-inch belt-driven, pressure of 100 pounds per square inch single-stage compressor of the totally enclosed type was also displayed This exhibit included other pneumatic equipment and a photographic display of machinery made by the Sullivan company.

In addition to a large motor-driven air compressor, which delivered air to some of the pneumatic tool exhibits, the Chicago Pneumatic Tool Co., Chicago, showed a full line of pneumatic hoists, chipping hammers, rammers, drills, grinders, and electric drills, sand shakers, etc. A pneumatic hammer and a drill, with sections cut away to show the valve mechanism in action, were interesting features of this exhibit.

Pneumatic tools and accessories including 250 different pieces of equipment were exhibited in the booth of the Cleveland Pneumatic Tool Co., Cleveland. Sand rammers for floor, flask and bench ramming, chipping hammers, drills and portable grinders were shown in operation. The sand rammers are equipped with exhaust clips which deflect the exhaust air downward into the sand, thus protecting the operator. The portable grinders are designed for wheels from 6 to 10 inches in diameter and operate at from 3000 to 3300 revolutions per minute. Bowes air-hose couplings were also exhibited.

A vertical double-cylinder single-acting compressor, water cooled with a regulating sight feed splash oiling system was operated by the Curtis Pneumatic Machinery Co., St. Louis. This compressor supplied air for hoists and trolleys which formed part of the exhibit. A single I-beam hand operated bridge crane with trolley and a single I-beam bracket jib crane were shown. Vertical cylinder air hoists suspended from I-beam trolleys were also exhibited.

Centrifugal air compressors for cupola blowing formed an important part of the exhibit of the General Electric Co., Schenectady, N. Y. One of the compressors was provided with a 50-horsepower alternating-current motor drive and the other with a 20-horsepower direct-current motor drive. The compressors are adapted to motor or turbine drive. The unit driven by the 50-horsepower motor has a capacity of 7200 cubic feet of air per minute. When driven by a direct-current motor, the pressure is regulated by changing the speed of the set by a field rheostat. When driven by an induction motor, the blast is regulated instead of the motor. The core oven exhibit of the General Electric Co., is described elsewhere in this article

Welding and Cutting Apparatus

The exhibits of welding and cutting apparatus for foundry cleaning rooms and for general repair work were unusually interesting because in practically every booth where this type of equipment was displayed, demonstrations of the actual process of cutting or welding were given. The Oxweld Acetylene Co., Newark, N. J., produced acetylene in a generator having an hourly capacity of 50 cubic feet. This gas was used in cutting and welding pipe and other iron and steel articles. The exhibit also included a display of welding and cutting torches, tips, etc.

A large crankshaft welded by the thermit process was exhibited by the Goldschmidt Thermit Co., New York. Pictures of unusual welding jobs were displayed, and pieces of plain, coupled and welded pipe which had been tested for tensile strength, bursting strength and vibration were shown. Samples of carbon-free metals and alloys made by the Goldschmidt company were shown.

The Davis-Bournonville Co., Jersey City, N. J., exhibited various kinds of oxy-acetylene cutting and welding apparatus and accessories. The accurate cutting of plates by an acetylene torch was demonstrated on a machine provided with a table for holding the work and a special holder for the torch. The latter has a pantograph motion which enables the operator to easily control the movement of the torch. Gas used in the cutting and welding apparatus for demonstrating purposes was generated in a generator made by the Davis-Bournonville Co.; it had a capacity of 100 cubic feet of acetylene per hour.

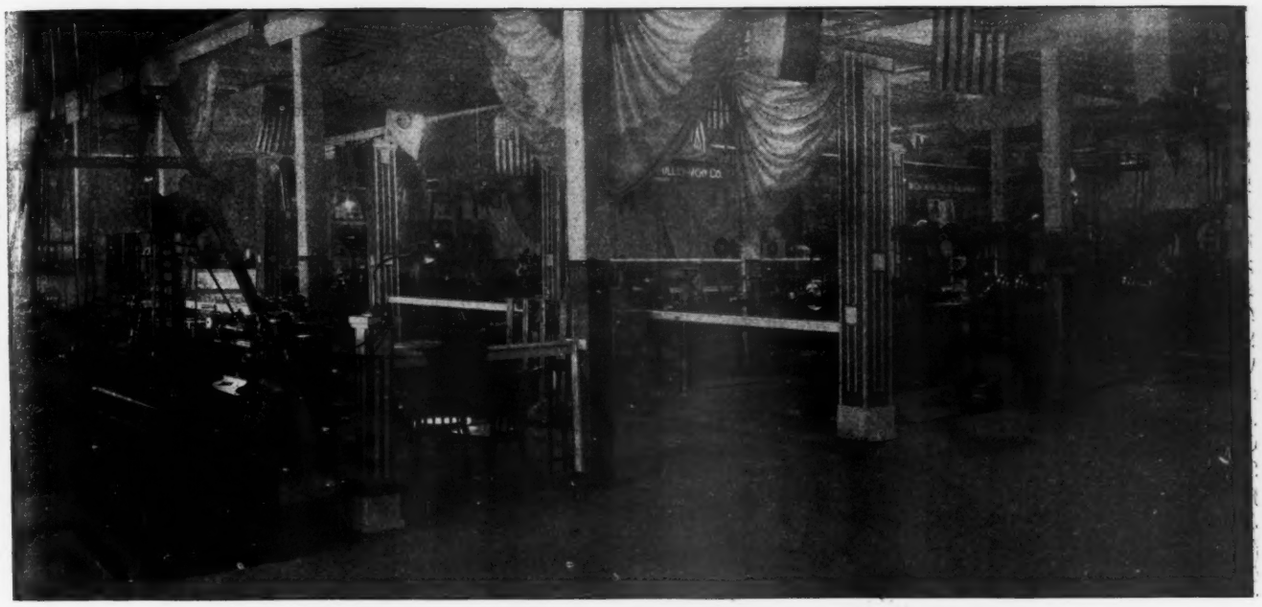
Grinding wheels and abrasive materials were shown by the Carborundum Co., Niagara Falls, N. Y. Divine Bros., Utica, N. Y., displayed a number of compress polishing and buffing wheels, glue for polishing purposes, and cushion wheels for trucks.

Among the companies exhibiting crucibles were the Joseph Dixon Crucible Co., Jersey City, N. J.; New Chicago Crucible Co., Chicago; Foreign Crucible Corp., Ltd., New York; and the O. K. Crucible Co., New York.

The manufacturers of metals and al-

Flag Raising Ceremonies

ON THE stage overlooking the Grand hall of the Mechanics' building during the entire exhibition week floated the national ensigns of the three major allies, England, France and the United States. The American flag, as was appropriate, was on the highest staff in the center. Every morning promptly at 9:30 a file of marines from the Boston navy yard raised the flags with full military honors, while the orchestra played "God Save the King", the "Marsellaise" and the "Star Spangled Banner". A large audience attended this effective ceremony every day. Thus again was the theme of national service emphasized and the unity of the great democracies of the world demonstrated.



MACHINE TOOLS OF MANY TYPES WERE DISPLAYED IN THE BASEMENT

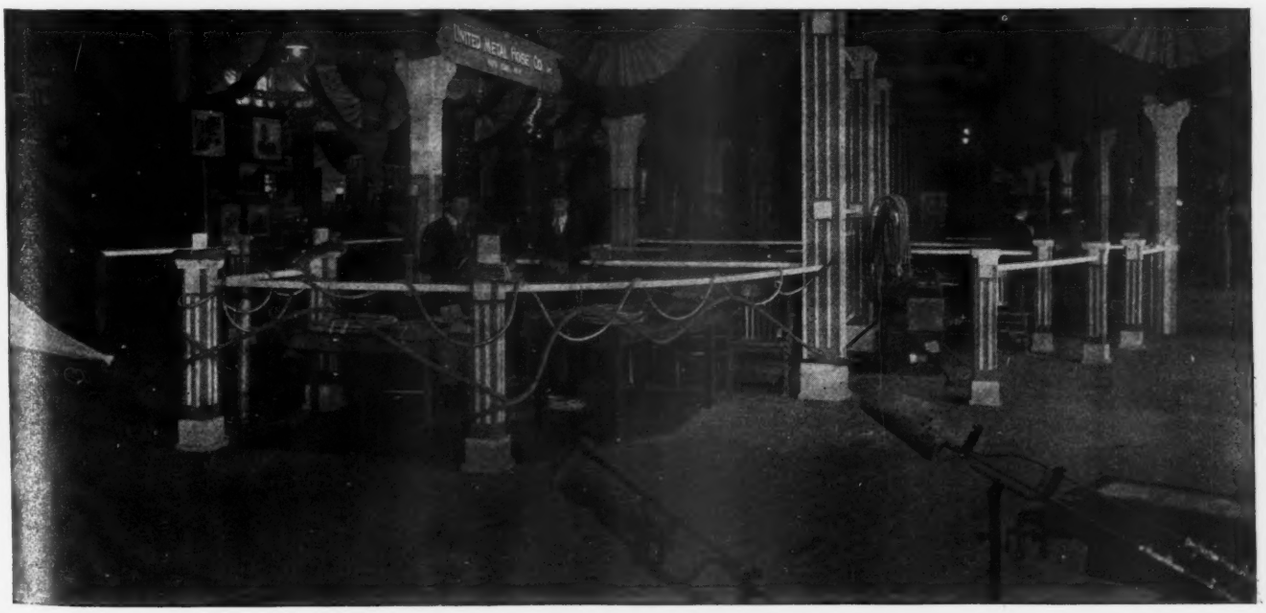
loys used in the foundry industry departed from the usual display of ingots, and arranged interesting exhibits of castings made from their metals. This was especially true of the booth of the Ajax Metal Co., Philadelphia. The castings shown included a submarine-engine base of extra strong manganese bronze, plastic bronze bushings, bearings and boxes for large locomotives, machine-gun castings, railroad-car fittings, fire-engine castings and turbine parts. Ingots of various metals and alloys made by this company were also shown.

Castings made from metals of the Michigan Smelting & Refining Co. were shown. This company also showed ingots of copper, brass, tin, babbitt, special alloys and aluminum. Other exhibitors of metals and alloys who showed ingots and castings were the Eastern Brass & Ingot Corp., Waterbury, Conn., and S. Birkenstein & Sons, Chicago. The Titanium Alloy Mfg. Co., Niagara Falls, N. Y., exhibited ferro-carbon-titanium and castings made by the Titanium Bronze Co., Niagara Falls, N. Y., an allied company.

Attractive Display of Coke

In this year's show, as in those of the past, the exhibits of coke were unusually attractive. The large reproduction of Bunker Hill monument executed in coke made by the New England Coal & Coke Co. stands out as the most elaborate exhibit of the Boston show. This monument, rising nearly to the ceiling of the Grand Hall, was surrounded by four large statues showing typical Puritans in the costume of their time. Colored lights hanging in festoons from the top of the monument and potted plants added to the attractiveness of the exhibit.

The exhibit of Pickands Brown & Co., Chicago, consisting of a large hub made of Solvay coke, attracted considerable attention. Rogers, Brown & Co., Cincinnati, displayed a large number of fine castings made from the various grades of pig iron handled by that company. Samples of many kinds of pig iron, bee-hive and by-product cokes, and ferroalloys were shown. The Debevoise-Anderson Co., Inc., New York, showed samples of coke, pig iron, limestone, coal and 50 per cent ferro-



A GLANCE AT THE EXHIBIT IN EXHIBITION HALL

silicon. The Thomas Iron Co., Easton, Pa., showed samples of pig iron, and test bars and typical castings from the iron made by the company.

Many Core Binders Displayed

As usual, the manufacturers of core compounds maintained comfortable booths for visiting foundrymen and displayed cores and castings in which their products were employed. Among the exhibitors of core compounds were the American Gum Products Co., New York; Robeson Process Co., New York; Werner G. Smith Co., Cleveland; Spencer Kellogg & Sons, Inc., Buffalo; Cataract Refining & Mfg. Co., Buffalo; United Compound Co., Buffalo; United States Graphite Co., Saginaw, Mich.; J. S. McCormick Co., Pittsburgh; Corn Products Refining Co., New York.

Core and mold ovens of the car and drawer type, core cars, melting furnaces, oil burners, etc., were shown in the booth of the Foundry Equipment Co., Cleveland. The General Electric Co., Schenectady, N. Y., operated an electric core oven made by the Oven Equipment & Mfg. Co., New Haven, Conn. The oven is equipped with pyrometers made by the Taylor Instrument Co., Rochester, N. Y. Green cores were dried in this furnace throughout the week. The G. S. Blodgett Co., Burlington, Vt., exhibited three types of core baking ovens.

Crucible and non-crucible melting furnaces were shown by the Buckeye Products Co., Cincinnati. The Ludlum Electric Furnace Co., New York, showed a working model of the new Ludlum furnace. Samples of the castings from this furnace and pictures of the furnace in actual operation were displayed. The Monarch Engineering & Mfg. Co., Baltimore, exhibited an unusually complete line of tilting, stationary and portable furnaces for melting metals. In addition to a large variety of miscellaneous foundry equipment, the S. Obermayer Co., Chicago, exhibited a brass melting furnace.

Melting Fire Brick

The Quigley Furnace Specialties Co., New York, demonstrated a high-temperature cement adapted for use in repairing crucibles, lining cupolas and melting furnaces, etc. Brick which had been bonded by the cement was burned in an electric furnace at a heat of about 3200 degrees. Methods of repairing crucibles were shown in pictures.

The General Fire Extinguisher Co., Providence, R. I., exhibited various parts of automatic sprinkling equipment, including the telegraphic equipment for central station alarms. A sprinkler head in a glass covered compartment afforded an opportunity for demonstrating the action of the heads when subjected to the heat of a fire.

Wood blocks for floors were exhibited by Ayer & Lord Tie Co, Chicago, and the Jennison-Wright Co., Toledo, O. Safety equipment including shoes, goggles, clothing, etc., was shown by the Safety First Shoe Co., Providence, R. I.; R. P. Smith & Sons Co., Chicago; Strong, Kennard & Nutt Co., Cleveland; Julius King Optical Co., New York.

Electric hoists for foundries were shown by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Monorail track, and trolley accessories were also shown. Photographs of hoisting apparatus were displayed by the Hayward Co., New York.

Many Machine Tools Shown

An unusually large variety of machinery for machine and pattern shops was displayed at the Boston show. The Gardner Machine Co., Beloit, Wis., exhibited horizontal and vertical disc grinders, several of which were equipped with exhaust systems. A horizontal disc grinder, motor driven and provided with an exhaust blower made by the Buffalo Forge Co., Buffalo, N. Y., attracted considerable attention. Samples of work done on disc grinders were displayed.

Belt and motor-driven grinding and polishing machinery was displayed by the Bridgeport Safety Emery Wheel Co., Bridgeport, Conn. A thread-milling machine and a gear generator built by the Lees-Bradner Co., Cleveland, were exhibited by Lynd-Farquhar Co., Boston, New England representatives of the Lees-Bradner Co.

Four double-spindle grinding machines were shown in operation by the Norton Co., Worcester, Mass. The safety devices attached to these machines were noticeable, the wheels being protected by guards and the belts being screened by box-shaped wire cages. Each machine was equipped with an exhaust system for carrying away the dust. In addition to the grinding machines, a wide variety of wheels for various kinds of grinding work were displayed.

Quick-change drill chucks were demonstrated by the McCrosky Reamer Co., Meadville, Pa. This exhibit also included adjustable and plain reamers, tool posts for lathes, holders for turret lathe tools, and universal lamp brackets for machine tools. Part of this equipment was shown in actual use on drills and lathes.

The Oliver Machinery Co., Grand Rapids, Mich., exhibited a 16-inch toolroom lathe. Pictures of pattern-shop machinery, including a universal wood milling machine were shown. A pipe bending machine equipped with adjustable parts for bending pipe into various intricate shapes was demonstrated by representatives of the American Pipe Bending Machine Co., Boston. Internal grinders, a threading tool, and a back-geared precision bench lathe mounted on a cabinet with individual motor-drive and attachments were shown by the Rivett Lathe & Grinder Co., Boston.

Hack saw blades, and frames, hand saws, circular saws, metal cutting machines and core plates were shown by the E. C. Atkins & Co., Indianapolis, Ind. The Athol Machine Co., Athol, Mass., displayed a large variety of shop tools including calipers, dividers, and vises. The vises are equipped with nonslidable handles, which have a ratchet connection with the vise-head screw, allowing the handle to be swung at any desired handle without disturbing the position of the vise jaws. A feature of the exhibit is a small model of a meat chopper, the first invention of L. S. Starrett.

Four power-driven magnetic separators were exhibited by the Dings Magnetic Separator Co., Milwaukee. One of these machines was equipped with a motor, another with a motor-generator set and a third with a hand magnet. The other separator was of the magnetic pulley type with motor.

Other Exhibitors

Among the other exhibitors whose booths attracted attention were Felt & Tarrant Mfg. Co., Chicago; Abell-Howe Co., Chicago; Forbes & Myers, Worcester, Mass.; American Lighting Co., Chicago; Pittsburgh Crushed Steel Co., Pittsburgh; Armstrong Cork Co., Pittsburgh; Asbury Graphite Co., Asbury, N. J.; General Plater's Supply Co., New York; Hart & Hutchison, New Britain, Conn.; Hauck Mfg. Co., Brooklyn, N. Y.; Standard Equipment Co., New Haven, Conn.; Sterling Wheelbarrow Co., West Allis, Wis.; W. F. Stoddard, Syracuse, N. Y.; Frank D. Chase, Chicago; Chase Turbine Mfg. Co., Orange, Mass.; Lewis-Shepard Co., Boston; Chisholm-Moore Mfg. Co., Cleveland; United Metal Hose Co., New York; David Lupton's Sons Co., Philadelphia; Charles J. Clark, Chicago; Cleveland Blow Pipe & Mfg. Co., Cleveland; United States Silica Co., Chicago; Mahr Mfg. Co., Minneapolis; Malleable Iron Fittings Co., Branford, Conn.; Cleveland-Osborne Mfg. Co., New York; Thomas E. Coale Lumber Co., Philadelphia; White & Bros., Inc., Philadelphia; McLain's System, Inc., Milwaukee; Combined Supply & Equipment Co., Buffalo; Moltrup Steel Products Co., Beaver Falls, Pa.; Cutter & Wood Supply Co., Boston; T. B. Wood's Sons Co., Chambersburg, Pa.; Norma Co. of America, New York; G. Drouve Co., Bridgeport, Conn.

The Effects of Seasoning on Gray Iron Castings

Results of Tests on Cast Iron Surface Plates and Straightedges Subjected to Widely Varying Treatment—Many Problems Still Unsolved

By L M Sherwin

THE term seasoning is a very broad one and numerous definitions can be found covering various methods of procedure, but the one which has the most bearing on this subject is as Webster gives it, namely, "the maturing or the changing from the crude to the more perfect condition; to mature; to grow fit for use." This is what actually happens to gray iron castings when they are subjected to any process tending towards their improvement. The necessity for seasoning is due largely to internal strains and existing stresses arising usually from the design of the casting, or from some unusual condition such as heat and cold being applied to any one particular location on a casting and not to the other sections.

There are several different methods of seasoning castings in vogue at the present time, and it would be difficult indeed to determine without actual experimenting with the various processes just which method would be the more valuable and which one could be recommended the most highly. Individual requirements would be the governing factor in determining the method, and would therefore prevent making a general or definite assertion. Some of the methods being used are as follows:

1.—Castings remaining in one place and position for an indefinite period, and in some cases exposing them to weather conditions, before they are finish-machined.

2.—Castings having been rough-turned or planed, and then subjected to a heat of several hundred degrees, say as high as 400 degrees Fahr., for a definite period of time.

3.—Castings heated from 150 to 300 degrees Fahr., before having the scale removed.

4.—Castings heated and re-heated several times at 400 degrees Fahr.

It is generally recognized that there is some benefit to be derived from some sort of seasoning. It has been found that the castings after receiving this treatment will have a greater tendency toward holding their shape more permanently than those that have not received any treatment, and, as far as is known at the present time about straightedges, surface plates and other castings of a similar nature; the second method is believed to be more preferable and can be recommended for this purpose.

Much has been written about shrinkage, internal strains, external stresses and contraction, and all of these factors have a decided relation to the seasoning process. The shrinkage, both internally and externally, usually is the result of poor designing, but there are many instances where the mixture of the gray iron is entirely at fault, causing these unusual conditions. With a casting so designed that there are several, or even one heavy and one light section, the heaviest portion will naturally, be the last to become solid, which indicates that the lighter section on cooling drew the molten metal to that part and in so doing left void places in the heavy sections. The reduction in the various dimensions of a casting, after reaching the solidified state, is known as the contraction. Sometimes the internal shrink is referred to as the *spongy shrink*, and the external shrink as the *sucking in shrink*. The former in many cases is caused by the carbon in the mixture being too high, while the latter is due to too low carbon in the mixture. The above conditions will effect the strains and stresses, and, as these are the governing factors regarding seasoning, every known precaution that is practicable should be observed in order that castings to be seasoned will be sound and be

FIG. 1—MICROGRAPH OF TEST BAR *1A*
Heated at 1100 Degrees Fahr. for 24 Hours—Microstructure Unchanged—Magnified 100 Times

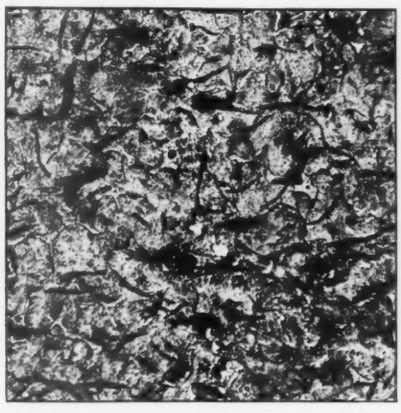


FIG. 2—TEST BAR *1A*
Magnified 500 Times

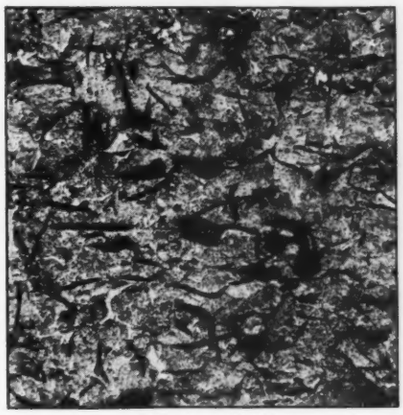


FIG. 3—MICROGRAPH OF TEST BAR *2A*
Microstructure as Cast—Magnified 100 Times

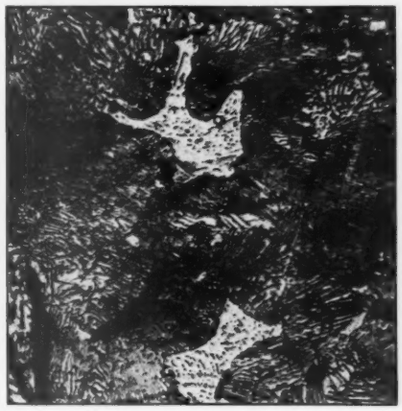


FIG. 4—TEST BAR *2A*
Magnified 500 Times

A paper presented at the Boston meeting of the American Foundrymen's association. The author, L. M. Sherwin, is associated with the Brown & Sharpe Mfg. Co., Providence, R. I.

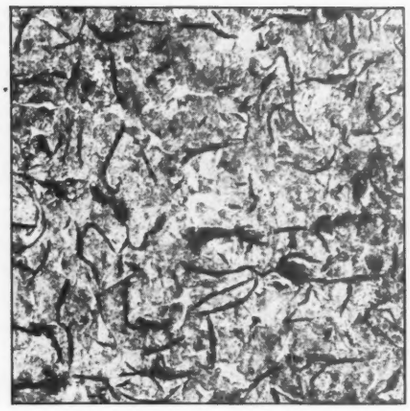


FIG. 5—MICROGRAPH OF TEST BAR *3A*
Microstructure as Cast—Magnified 100 Times

FIG. 6—TEST BAR *3A*
Magnified 500 Times

of good texture, regardless of the method which is to be used later in seasoning. The casting undergoes expansion and contraction during the process of cooling from the molten state to the solidified condition and after reaching this state the mobility of the molecules will allow for seasoning.

Many interesting experiences and facts have been brought out during the past few years in connection with seasoning and several experiments carried through which have proved more or less successful. At the present time tests and experiments are being conducted with surface plates and straightedges to determine the best and most economical method of handling gray iron castings for these purposes.

Several years ago an elaborate system, consisting of a large box containing coils of steam pipes, was installed. The castings were placed in the box and live steam passed over the castings through the pipes; thus raising the temperature in the box to the desired degree. This system was discarded as being too expensive for the results obtained. The value of this method has always been a more or less debated question.

Various efforts have been made to equalize the strains and stresses. Some of these have been the designing of a surface plate with two parallel faces and a uniform distribution of metal throughout. This particular casting has been in daily use for several years and seems to be giving entire satisfaction. The casting was first rough-planed and then heated. Also there have been castings such as sliding tables designed with several medium and light sections, as well as other castings with all the sections of relatively the same proportions and weight. Experience has proved the uniformly designed table to be less changeable. It is probable that by heating the former castings to some definite degree for several hours their tendency to warp would be materially lessened.

Instances where manufacturers have claimed that a certain straightedge had changed its shape during the day have been investigated, and it was found that the room temperatures were affecting the marking (the marking is shown by rubbing the prepared surface against a master plate). The temperature of the room in such cases was about 60 degrees Fahr. Upon raising the temperature to 70 degrees the trouble was entirely eliminated.

It has also been found that the temperature will materially affect the marking of all surface plates and straightedges, and the most satisfactory temperature for working conditions at which the marking and scraping is done is about 70 degrees Fahr. It is almost impossible at the present time, unless under ideal conditions regarding room temperatures, to scrape and mark these castings in one continuous period. Some castings are started and worked on for one-half hour between the hours of 7:00 a. m. and 7:30 a. m., then they are laid aside for two hours and at 9:30 a. m. the scraping is again started and finished. The change under these conditions is no greater than 0.001 inch in a length of 6 feet. In the winter the changes referred to are more perceptible than in the summer, and the long narrow castings show a more noticeable change between the temperature of 60 degrees Fahr. and 70 degrees Fahr. than from 70 degrees Fahr. to 80 degrees Fahr. A difference of 10 degrees makes a change in the marking of approximately 0.001 inch. If a straightedge is marked and scraped at 70 degrees Fahr., then marked again at 85 degrees Fahr., it is

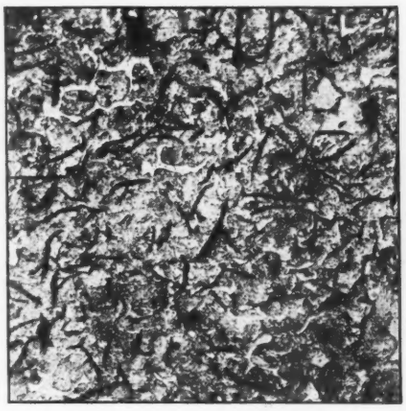


FIG. 9—MICROGRAPH OF TEST BAR *1A'*
Microstructure as Cast—Magnified 100 Times

FIG. 10—TEST BAR *1A'*
Magnified 500 Times

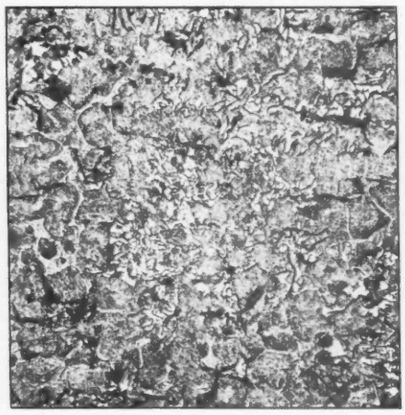


FIG. 7—MICROGRAPH OF TEST BAR *4A*
Microstructure as Cast—Magnified 100 Times

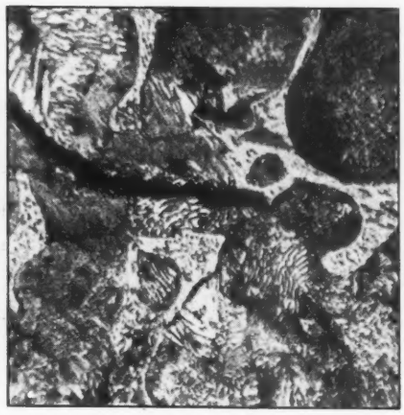


FIG. 8—TEST BAR *4A*
Magnified 500 Times

very seldom that any change can be detected. If, on the other hand the castings are marked and scraped at 70 degrees Fahr., to say 60 degrees Fahr., a noticeable change takes place. Of course, where there are heavy and light sections and corresponding strains and stresses, the light sections are more easily affected by the rise and fall of the temperature.

The placing of the bare hand on the center of a straightedge 4 feet long in less than half a minute changes the marking. Consequently, all surface plates and straightedges are fitted with wooden handles to be used by the workman to prevent this change from heat. The sunlight coming through a window and striking such castings quickly changes them.

When working on straightedges, one man has three straightedges, and, if on surface plates, he has two. The trouble is usually encountered in the machining and scraping, and it is a very expensive proposition to refinish these castings after they have been once finished. Therefore, every precaution is taken to make the casting as nearly correct as possible. The best results can be obtained by seasoning.

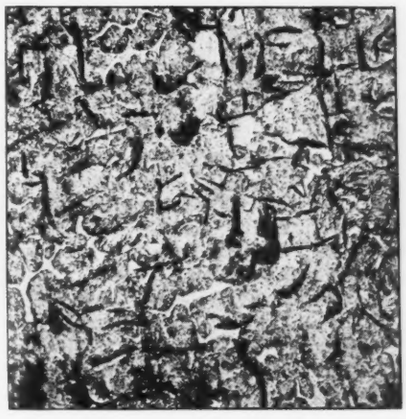


FIG. 11—MICROGRAPH OF TEST BAR *2A'*
Heated at 1100 Degrees Fahr. for a Period of 1 Hour, Three Different Times—Microstructure Unchanged—Magnified 100 Times

Every surface plate and straightedge is first rough-planed and then subjected to a temperature varying from 350 to 550 degrees Fahr., depending entirely on the size, shape and class of the castings. Some castings require 350 degrees, others 400 degrees Fahr., while still others may require 500 degrees Fahr. After heat treating, the castings are finish-machined and then scraped.

It is wrong to assume that after a casting has been seasoned that it will be immune from any changes. Excessive heat and cold will always affect the castings, but after the cause has been removed the castings return to their original shape unless the heat or cold has been so intense that the castings have become warped. In such an event, re-machining is necessary.

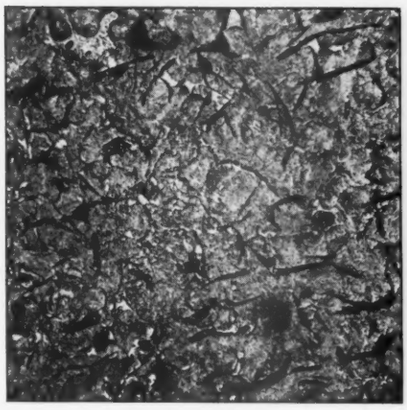


FIG. 13—MICROGRAPH OF TEST BAR *3A'*
Heated at 400 Degrees Fahr. for 16 Hours, Microstructure Unchanged—Magnified 100 Times

Long narrow plates give far more trouble in machining and scraping than square castings. Very little difficulty is experienced with narrow castings of short lengths.

FIG. 12—TEST BAR *2A'*
Heated at 1800 Degrees Fahr. for 24 Hours, Pearlite Completely Decomposed—Microstructure Unchanged—Magnified 500 Times

Castings which have not been heat-treated and are left for a long period of time in the yard exposed to the weather, are found to be seasoned to an extent about equal to that which the castings receive from heat treatment. If unlimited time could be given to castings which need fine finishing and scraping, they could undoubtedly be seasoned as well without heat as with it, but the condition of manufacturing at the present time makes this difficult.

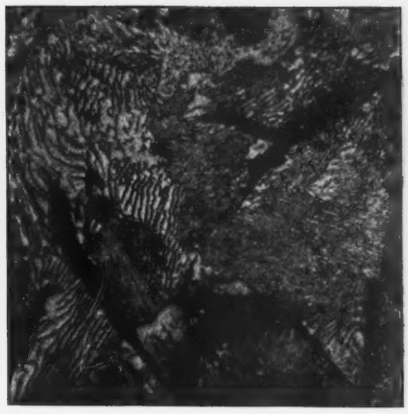


FIG. 14—TEST BAR *3A'*
Magnified 500 Times

It has been reasoned that if heating to from 300 to 500 degrees Fahr. proves beneficial, why would not a higher temperature be more effective? On the assumption that this theory is correct, we have at the present time various castings undergoing this treatment. The castings have been carried through the various processes up to scraping and marking, and it is to be regretted that more time was not available for the completion of these experiments. To date the results have been fairly satisfactory, but they have not reached the stage where they could be tabulated with any degree of certainty as to their correctness. The relative merits of the plates heated to 400 and 1100 degrees Fahr. are about equal. Before proceeding with these experiments it was

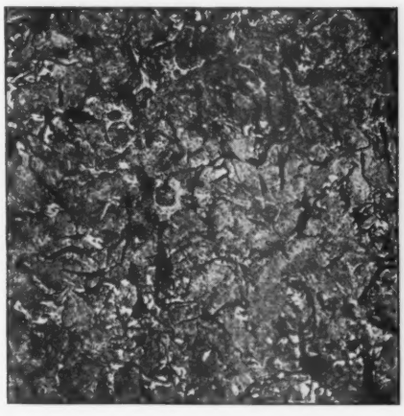


FIG. 15—MICROGRAPH OF TEST BAR *4A'*
Microstructure as Cast—Magnified 100 Times

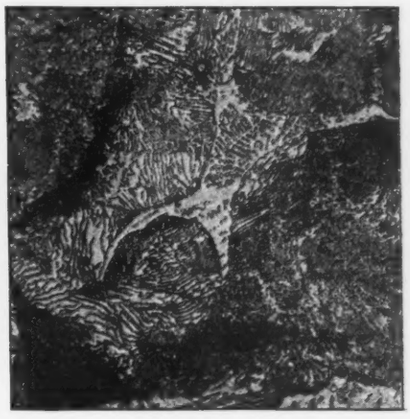


FIG. 16—TEST BAR *4A'*
Magnified 500 Times

Chemical Composition of Test Bars

	1A	1A′	2A	2A′	3A	3A′	4A	4A′
Silicon	1.86	1.87	1.75	1.83	1.91	1.93	1.95	1.97
Sulphur	0.116	0.115	0.118	0.119	0.080	0.075	0.081	0.078
Manganese	0.56	0.52	0.54	0.51	0.51	0.53	0.51	0.53
Phosphorus	0.49	0.42	0.44	0.41	0.49	0.45	0.48	0.47
Combined carbon	0.73	0.69	0.71	0.65	0.79	0.67	0.68	0.64
Graphitic carbon	2.47	2.47	2.47	2.51	2.57	2.61	2.77	2.75

Tensile Tests

Bar	Pounds per square inch
1A	37,200
2A	37,000
3A	36,300
4A	34,300
1A′	36,900
2A′	35,100
3A′	36,000
4A′	85,400

Scleroscope Test

Bar	Number
1A	36
2A	34
3A	33
4A	36
1A′	35
2A′	35
3A′	33
4A′	37

Brinell Tests

Bar	Number
1A	207
2A	207
3A	187
4A	183
1A′	192
2A′	196
3A′	187
4A′	196

absolutely necessary to determine what temperature would be a safe maximum to adopt for the treatment of the castings when considering the wearing qualities, shape, etc. The transformation range for cast iron of this grade is between 1250 and 1375 degrees Fahr. This means that when heated above the latter temperature the combined carbon, structurally termed pearlite, is changed slowly into its elements, namely, iron and carbon. Later at a higher temperature the graphite increases the size of the previously formed graphite.

Carefully conducted experiments with this iron to obtain heating and cooling curves resulted in establishing the arresting point on cooling at 1330 degrees Fahr. A long period of heating at a temperature below this range, namely, 1100 degrees Fahr., should not affect the microstructure of any component. To verify these premises was one of the objects of the heat-treating experiments.

Twenty castings were used in these experiments and were cast at approximately the same time in the heat and under the same conditions, such as rapidity of pouring and temperature of the metal. The castings were all removed from the sand at about the same time and were given an equal chance for cooling. All were rough-planed and some of them subjected to various heats while others did not undergo the heat treatment.

The castings used in the experiments were four straightedges, 1⅞ x 36 inches; six straightedges, 2 x 48 inches; four surface plates, 24 x 48 inches; and six surface plates, 6 x 26 inches. A set of two test bars were cast with the same mixture and at the same time as were each of the four 24 x 48-inch surface plates, and marked 1*A*, 1*A*′, 2*A*, 2*A*′, 3*A*, 3*A*′, 4*A*, and 4*A*′. The bars, 1*A*, 2*A*, 3*A* and 4*A* were tested as cast. Bars 1*A*′, 2*A*′, and 3*A*′ were tested after being heated as follows:

1*A*′ heated to 400 degrees Fahr. for a duration of 24 hours.
2*A*′ heated to 1100 degrees Fahr. for a duration of 24 hours.
3*A*′ heated to 1100 degrees Fahr. on three different occasions and cooled in each case.

The bar 4*A*′ was tested as cast. In each case the bars *A* and *A*′ were cast at the same time and in the same mold.

Another test bar, *B*, cast of the same quality iron, was then heated to 1800 degrees Fahr., but the micrograph proves the method to be undesirable.

It was desired to ascertain, if possible, the differences in the chemical composition and physical condition between the bars as they were cast and after being heated to various temperatures. The four 1⅞ x 36-inch straightedges were treated as follows:

1.—Heated to 400 degrees Fahr. for a duration of 24 hours.
2.—Heated to 400 degrees Fahr. for a duration of 72 hours.
3.—Heated to 400 degrees Fahr. for a duration of 168 hours.
4.—No heat.

The 2 x 48-inch straightedges were treated as follows:

1.—Heated to 350 degrees Fahr. for a duration of 24 hours.
2.—Heated to 350 degrees Fahr. for a duration of 48 hours.
3.—Heated to 350 degrees Fahr. for a duration of 72 hours.
4.—Heated to 1100 degrees Fahr. for a duration of 24 hours.
5.—Heated to 1100 degrees Fahr. three different times and cooled in each case.
6.—No heat.

The 6 x 26-inch surface plates were treated as follows:

1.—Heated to 400 degrees Fahr. for a duration of 24 hours.
2.—Heated to 1100 degrees Fahr. for a duration of 24 hours.
3.—Heated to 1100 degrees Fahr. on three different occasions and cooled in each case.
4.—Heated and re-heated several times at 400 degrees Fahr.
5.—Placed in yard for an indefinite length of time.
6.—No heat.

The 24 x 48-inch surface plates were treated as follows:

1.—Heated to 400 degrees Fahr. for a duration of 24 hours.
2.—Heated to 1100 degrees Fahr. for a duration of 24 hours.
3.—Heated to 1100 degrees Fahr. on three different occasions and cooled in each case.
4.—No heat.

The chemical analyses of the test bars and the results of physical tests are shown in the accompanying table.

In my estimation the subject of seasoning gray iron castings has never received the amount of attention it justly deserves, and, as this work covers individual requirements, the subject has been approached from experiences within our field of endeavor and which have come under our observation.

The following questions have been asked and up to the present time the writer feels that the answers are still a matter of personal opinion and still remain in doubt. Therefore the questions cannot be answered fully and correctly. The questions are:

1.—What are the actual relations of seasoning to internal and external stresses and strains?

2.—Will the chemical composition have a direct bearing on results for castings to be seasoned?

3.—What is the quickest and most accurate way of determining whether the castings are stressed; and, if such is the case, what is the most effective way of realizing the value of these stresses?

4.—What is the best method of seasoning to determine which process would be of the greatest value and at the same time the most economical?

FIG. 17—MICROGRAPH OF TEST BAR *B*
Heated at 1800 Degrees Fahr. for 24 Hours—Pearlite Completely Decomposed—Graphite Flakes Larger—Phosphide Structure Altered—Magnified 100 Times

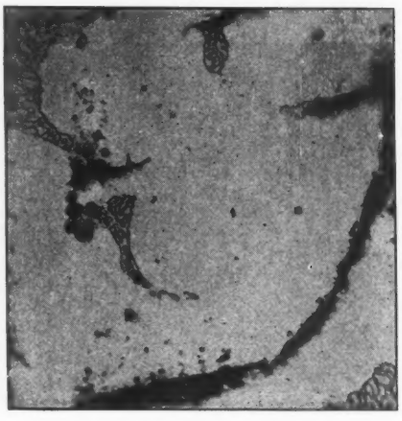


FIG. 18—TEST BAR *B*
Magnified 500 Times

Making Cast Iron Shells in Permanent Molds

Advantages of Cast Iron and Steel Shells Compared—How Difficulties in Molding May Be Overcome—German and French Practice

By Edgar Allen Custer

THE present conflict has brought about wonderful changes in the generally accepted ideas of warfare. The terrible curtain of fire has made its appearance, earthworks and trenches have been substituted for elaborate and costly fortifications and the aeroplane and submarine have profoundly influenced the strategy on land and sea. In the trenches, old-time stink pots and grenades are being thrown by the ancient catapult, bombs are shot from a contrivance that closely resembles a home-made Fourth-of-July cannon and the form of slingshot that David used on Goliath, has been modernized to a wonderfully effective point. Now we have the spectacle of an unheard of number of rapid-fire, high-caliber guns raining upon the enemy, myriads of cast-iron shells. The continued use of these apparently grotesque contrivances and the revival of cast-iron shells rests on the fact that they have been found to be the most effective means for doing the work in hand.

Cast-Iron Shells Not New

There is nothing new in the use of cast-iron projectiles—before the age of steel they were the sole means of battering down defenses and attacking at long range. Some of the reasons why the use of cast-iron shells was abandoned are that the metal has never had a very good reputation for uniformity and freedom from sponginess and gas holes; its tensile strength is low and it lacks toughness. Any of the defects commonly found in cast iron will seriously affect the trajectory and direction of a shell and render it comparatively useless. It must be absolutely reliable and land at the point at which it was aimed. If one portion is spongy and hence lighter, it will wobble in flight and its main purpose will be destroyed. The weakening effect of sponginess or blowholes may cause the shell to break under the shock of the initial explosion and destroy the gun. A forged steel projectile meets all these objections and has the call.

The objection to steel projectiles is that they are comparatively ineffective against earthworks or trenches when the caliber is 5 inches or less. The amount of contained explosive is small and a great proportion of the explosive effect is used in bursting the walls of the shell. In larger sizes this objection is less apparent. The explosive effect increases with the added charge in a greater ratio than the strength of the added amount of metal in the projectile. The present war has taught us that steel, concrete and brickwork offer but little resistance to modern seige guns and they have been abandoned for earthworks manned with an ample force. The burden of attacking must and does rest with the artillery and the army that is equipped with the most effective guns using the most effective projectiles, will win the most battles. The projectile that is most efficient against earthworks and covers its zone of dispersion with the greatest number of fragments of the proper size is the projectile that will surely be used. It only remains to make that projectile so that it not only will be strong enough to resist the propelling explosion, but also will be perfectly sound and uniform in texture.

During the Spanish-American war, when our fleet was off Santiago, it was observed that one vessel was creating great havoc in the earthworks guarding the entrance, and upon investigation, it was found that this vessel was using loaded practice shells. These shells would tear great holes in the works, while the steel shells were comparatively ineffective. As the vessel had quite a number of these shells in stock, it became very popular with the other ships. A few years ago, some experiments were made on the lower Chesapeake to determine the effect of cast-iron shells on the superstructure of a condemned war vessel. One shell that penetrated the structure and burst in a wardroom was particularly observed. The room was about 20 x 60 feet and one side was lined with lockers. Every locker was torn to pieces and the paint on the walls and ceiling in the line of the explosive force was cut off as with a sand blast. It was the unanimous opinion that the explosion would have killed every man who happened to be in the room at that time. A few tentative experiments were made after this and a permanent mold was constructed, but the project was allowed to drop and no effort was made to thoroughly investigate the subject.

The first intimation we had that cast-iron shells were being used in the present war, was an article in the *London Engineer,* which described a number of fragments of cast iron that were undoubtedly portions of an exploded shell. It was noted that some of the pieces were slightly chilled on one side and the *Engineer* surmised that cast-iron cores were being used. As the peculiarly destructive effect of these shells was observed not only in the open, but also against earthworks, the idea that the Germans were using cast-iron shells on account of the scarcity of steel was abandoned. As a matter of fact, as early as May, 1913, German and Italian munition makers were discussing this phase of projectile work and were seeking all the information that was available. In August, 1913, it was reported to the writer that shells had been made that were satisfactory in that they had the proper degree of fragmentation and were strong enough to resist the effect of the propelling charge. Moreover, these shells were made in iron molds with iron cores.

Theory of the Cast-Iron Shell

The theory of the cast-iron shell is that, when used against earthworks, the greater part of the explosive force is not expended in bursting the walls of the shell and the effect is as if that amount of explosive were detonated in the earthwork. When used in the open, the great fragmentation of cast iron will allow the shell to burst into a far greater number of pieces than a steel shell and will cover the zone of dispersion very closely. It is essential for the work that the degrees of fragmentation be calculated to a nicety. Too great fragmentation will make the shell ineffective. A steel shell weighing 13½ pounds, when charged with one pound of TNT, will burst into approximately 1050 pieces if there is complete detonation. The largest pieces average 0.3 to 0.4 pound in weight and many of these are splinters due to the fibrous nature of the metal. The fragments recoverable have a wide variation in weight, as shown by the fact that while the average weight of the large fragments is almost half a pound, the average weight of all the fragments is

A paper presented at the twenty-second annual meeting of the American Foundrymen's association at Boston, Sept. 25-28, 1917. The author, Edgar Allen Custer, Philadelphia, is an engineer who has specialized on making castings in permanent molds for over a decade.

about 0.01 pound. It follows that a very large per cent of the fragments would do no harm or at least would not disable except at very close quarters. A cast-iron shell under the same conditions would burst into nearly 1500 pieces with the fragments comparatively uniform in size and weight. It has been found that wide differences in the fragmentation of steel shells have been caused sometimes by the incomplete detonation due to the primer failing to function properly. This is not so serious with the weaker cast iron, but serves to emphasize the fact that a large proportion of the explosive force is expended in bursting the steel walls.

Target shells have been made of cast iron for many years and almost any foundry can make them. It is only essential that the casting be solid and capable of being machined to the proper sizes. The weight of the bursting charge is made up by thickening the walls. If it is not up to weight, a little sand is poured into the cavity. When it comes to making a projectile of cast iron that is to be used against an enemy, a number of difficulties are set up. It must be very strong, it must be easily machined, it must be absolutely solid and free from spongy spots and blowholes, and above all, every shell must have exactly the same degree of toughness. To meet these requirements, the foundry must be run on a strictly scientific basis. There can be no guess work or slipshod methods. When shells are cast in sand, the elements of carbon, silicon and manganese must be held to very definite limits, and these limits vary with the thickness of the shell walls. Moreover, these limits can only be determined by trial. The point aimed at is the correct degree of fragmentation and all foundry methods must be carried out with this point in view. Dry-sand molds, open and porous; perfect cores and trap or swirling gates must be used. The foundry requirements for this work have been ably set forth in an article by Edgar A. Custer Jr., in the April, 1917 issue of THE FOUNDRY and the methods of melting and care of iron and fuel described must be carried out whether the shells are made in sand or in a permanent mold.

Ordinary foundry iron when properly cast in a permanent mold and when removed at the proper time, has, in the resultant casting, the same degree of hardness irrespective of any variation in the chemical constituents, so long as the same size, weight and shape of casting is made. The time the casting remains in the mold is the determining factor of the degree of hardness. A casting weighing about 60 pounds remains in the mold four or five seconds, while a casting of the same general contour weighing 500 pounds will require from 25 to 60 seconds before it is safe to lift it out. To illustrate this point, data on a casting weighing 1100 pounds is presented. Fig. 1 shows the general outline of a mold that was used to make a shell bushing. It will be seen that a trap gate was used and that the casting had a very heavy base and comparatively thin upper walls. In fact, about 65 per cent of the total weight was concentrated in the lower third of the casting. This large mass of metal increased the time interval in that it was necessary to set the walls deeper than in a casting of smaller bulk. There were no risers and the only means provided for the escape of air from the matrix were a few shallow channels cut into the mold at the top of the casting. A large cast iron core operated by a hydraulic cylinder formed the interior cavity. The mold was opened and closed by a similar cylinder. Into this mold irons of the following analyses, all of which were melted in ordinary cupolas, were poured:

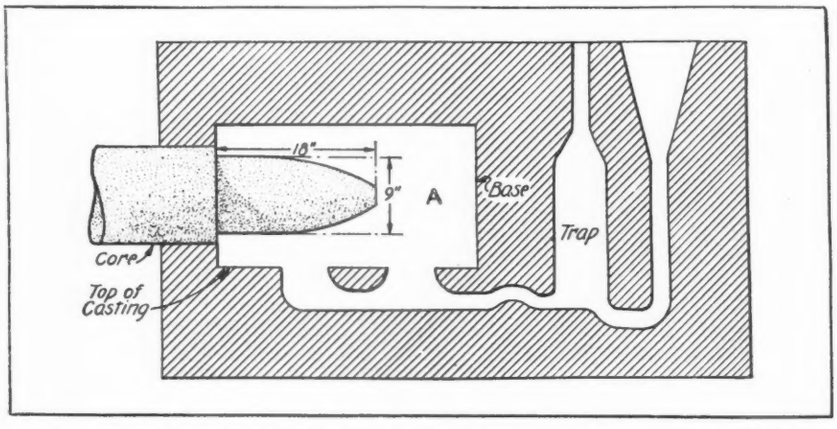


FIG. 1—TWO-PART CAST-IRON MOLD OF SHELL BUSHING WITH 15 INCHES OF METAL SURROUNDING GATES, RUNNERS AND CASTING

	Mixture			
	No. 1 Per cent	No. 2 Per cent	No. 3 Per cent	No. 4 Per cent
Manganese	1.50	0.50	0.80	1.50
Sulphur	0.03	0.05	0.06	0.03
Silicon	1.05	1.75	2.25	1.05
Phosphorus	0.05	0.06	0.06	0.05
Steel scrap.....	....	....	....	16.00

From 10 to 12 castings were poured from each of these irons and when the castings were broken, not one showed the least sign of sponginess or gas holes. The mold was poured full and the first part to freeze was the entrance gate so that there was no possibility of feeding. Only enough iron was poured to fill the cavity.

The time of setting was measured by the time the core remained in the casting before it was safe to draw it. No. 1 iron required 1 minute and 20 seconds before the core was drawn. When the core was allowed to remain in the casting 1 minute and 30 seconds, it was gripped by the iron and had to be cooled to room temperature before removal was possible. No. 2 iron required 1 minute, and No. 3, 30 seconds. In No. 4 a new condition was set up when 16 per cent of scrap steel was melted with the charge in the cupola. In this case it was 2 minutes and 20 seconds before the core could be withdrawn. The results show that in a casting of this size, the low silicon iron cools much slower than one of higher silicon content. The effect of the long time in the mold was to make the casting very hard and heat treatment was given to bring it to machinability. The temperature of the core had no effect on the time of setting, the tenth casting was given the same time as the first, although the core was heated to a temperature of over 400 degrees Fahr.

Mold for a Sixty-Pound Shell

A mold was made for a shell that, when finished, weighed 60 pounds. The mold was made in three parts, as shown in Fig. 2, and was equipped with a cast-iron core. It will be seen that the portion of the shell forward of the bourlette band is cast in the solid part of the mold and no provision is made for venting. The parting of the movable portions of the mold runs in a straight line through the center of the shell and extends 3 inches beyond the base. It then turns at an angle of 45 degrees and runs straight the remaining distance to the outside of the mold. The pouring cup is placed about 5 inches from the outer end of the parting and the main sprue runs down to an easy curve to the bottom of the trap. The entrance to the trap is ¾-inch in diameter, while the main sprue is 1½ inches in diameter. The trap gate is 5 x 4 inches with heavy filleted corners and open at the top. The sides are given ⅛-inch draft, so that the moving parts of the mold will open readily. The bottom of the trap is set low enough to allow a slight hump to be placed in the runner between the trap and the matrix. This hump serves to catch any air or dirt that may be carried with the first rush of the metal.

The center line of the runner is 3 inches below the bottom of the matrix and two gates are cut—one between the revolving band and the base and the other between the band and the bourlette. The gates are 1/16-inch wide and have a small fillet where they enter the matrix. The mechanism for drawing the core is attached to the part *A* and moves with it. Channels are cut in *A* and *B* in the proper position to receive the copper band. The operation of casting is as follows: The copper band is placed in the channels, the mold closed and then poured as fast as the runner will take the metal, keeping the pouring cup full until the end. In four seconds the core is withdrawn, the mold opened and the casting removed. The copper band will be firmly cast into place.

How Castings Are Toughened

It was found that a mixture corresponding to No. 4 in the experiment previously mentioned, with the exception that the manganese was under 0.08 per cent, gave the casting the toughness necessary for the proper degree of fragmentation, but the long exposure in the mold made the casting too hard. A scleroscope reading of 65 to 70 was the invariable result irrespective of any difference in the mixtures. It was evident that some form of heat treatment was necessary to bring the casting to a workable condition. It had been determined that a mark of 45 would give the proper degree of fragmentation. Quite a number of trials were made before it was found that a "flash" heat of 865 degrees Cent. would restore the casting to a good workable condition and bring the scleroscope to just about the correct figure. It was further found that the castings should be allowed to cool before being subjected to the treatment so that a number of shells could be treated at the same time, starting at the same basis of temperature. If the heating furnace has sufficient heat capacity, it requires about 20 minutes to bring the castings to the right temperature and they are then allowed to cool free from drafts.

In a permanent mold, it is impossible to get a casting free from gas or air holes without the use of trap gates. There is no trouble in filling the mold when semisteel is used. The metal does not need to be poured especially fast. Nevertheless, unless a substantial trap gate is provided, small holes will collect against the bottom of the core and the top of the casting. The most careful pouring will not change this condition. There is a point when semisteel can be poured in a permanent mold without these holes forming and without trap gates, and that point is when the metal has cooled until it is almost viscid. The difficulty of successfully hitting this point is so great as to make this method beyond the range of commercial success.

The difficulties that lie in the way of making a cast-iron projectile in sand have been set forth. Some of these troubles may be avoided by the use of a permanent mold. The selection of different irons for different sizes of shells is not necessary. To explain this, one must take into account the fact that the influence of silicon and manganese is exerted only when the molten metal is cooling in the mold and the total effect of this influence is measured by the time the molten metal takes to become solid.

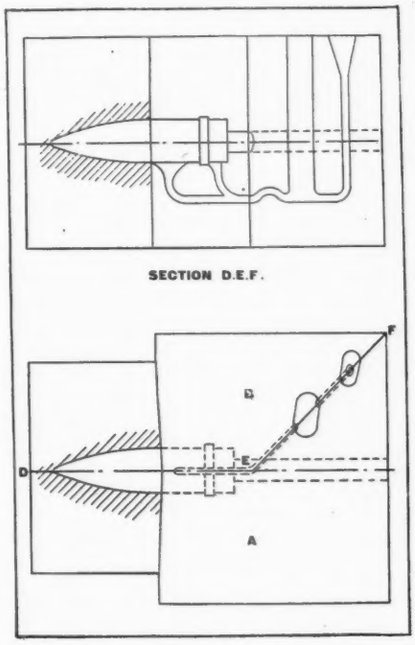


FIG. 2—SKETCH OF THREE-PART PERMANENT MOLD FOR A 60-POUND SHELL

In a sand cast projectile weighing 65 pounds, the time is five minutes, in a permanent mold casting the time is five seconds. The softening effect of silicon is due to its property of forming graphitis carbon—in itself silicon is a hardener. A casting with no carbon and high in silicon would be hard as glass. It requires a certain amount of time to form the graphite flakes and if this time is reduced to a minimum, the formation of these flakes will be prevented. Graphitic carbon will be present, but it will be in such a finely divided state as to be practically amorphous. It resembles the temper carbon of a malleable casting, but is uniformly distributed throughout the structure. Now if the time of setting is so short as to prevent the formation of graphitic flakes, it must follow that under these conditions, silicon has no softening effect. The same statement may be said as to the effect of manganese. A moderate amount of manganese will add strength to a sand casting and is a valuable constituent for a great variety of work. In a permanent mold casting the effect is to make the casting hard and brittle.

When cast-iron shells are used in the open, the fragmentation must be exact, but when used against earthworks, only the explosive force counts. Since it is impossible to set aside shells for each duty, it is obvious that the degree of fragmentation must govern the process. This is easier to accomplish with a permanent mold than by any other known process. As has been said, the question of hardness does not depend upon the variations of the pig iron so long as ordinary foundry iron is used. The same statement is true of the so-called semisteel so long as the same percentage of steel scrap is melted with the iron. The term "ordinary foundry iron" is used to denote pig iron ranging from 1.75 to 2.75 per cent silicon, below 0.80 per cent manganese and with sulphur below 0.08 per cent. Phosphorus has no appreciable effect up to 1.00 per cent. A casting that would analyze 3.00 per cent total carbon, 1.00 to 1.20 per cent silicon, 0.06 per cent manganese, 0.05 per cent sulphur and 16 per cent steel scrap would be an ideal composition for a 60-pound shell. All shells whether cast-iron or steel, must be subjected to a definite heat treatment and, in the case of cast-iron, the degree of heat and time of exposure to get the proper scleroscope test, can be determined only by experiment.

The Design of the Mold

Now a word about the design of the mold. The main point to be considered is that plenty of metal should surround not only the matrix, but also the sprues and runners. In a casting such as a 5-inch shell, there should be at least 10 inches of metal outside of every portion of the mold that comes in contact with the molten metal. The purpose of this is twofold, to provide a sufficient heat storage capacity so that the molten metal will be robbed of its heat in the shortest possible time and to make the mold strong enough to resist the tremendous expansive power of the cooling metal. The matrix and the core should be made to the exact size of the casting before finishing. Make no allowance for shrinkage. Why there is no apparent shrinkage when these castings are made in a permanent mold is a moot subject. It may be that since the interior of the casting is molten when it is taken from the mold and the outside contraction has not started at the time of removal, that the expansive force of the cooling interior metal will neutralize the contracting force of the cooling exterior. It is a very interesting point, but it is true that when the

casting is so thick that the interior is molten at the time of removal, shrinkage may be safely ignored.

Mold Should Open Easily

As a further item of design, the mold should be so equipped as to be easily and quickly opened and closed. The movable portions should run on grooved wheels fitting V-shaped tracks. The purpose of this is to prevent small particles of iron interfering with the adjustment of the moving parts. Casting is apt to be a sloppy proceeding and there are always small particles of iron splashing around. Mount the molds so that there is plenty of space underneath to collect any molten metal that may carelessly escape. Before closing the mold, run a flat scraper over the face to remove any small particles that may adhere. If these general rules are followed out, two 60-pound shells can be cast every minute and all will be of the same weight, size and texture.

There is one very important point in the manufacture of cast-iron shells that must be considered and that is the position of the copper revolving band. In some steel shells this band is placed within a very short distance of the base, but in a cast-iron shell, plenty of metal must back up the band. Even with the strength that steel gives, portions of the base are sometimes torn off by the tremendous force set up when the band enters the rifling at a very high velocity. The effect of this rupture is to disturb the trajectory and direction to such an extent as to render the shell not only useless, but dangerous. When the guns are behind the line, pieces of the band, base and even the projectiles may fall into friendly ranks with disastrous results. In a 5-inch shell, the distance between the band and the base must be at least 2½ inches and the band must be sunk into the body of the shell only sufficiently deep to hold it in position. If this point is not observed, the cast-iron shell will be a failure.

When the large projectiles are cast, there is a tendency to form wrinkles on the exterior and interior of the casting due to the surge of the metal while pouring. This is an annoying feature, but the remedy is to make the main runner, where it enters the trap, the controlling factor. If the diameter at that point be kept so small that the main runner can be kept full of molten metal during the entire pouring, these wrinkles will not be in evidence.

The question arises as to the use of steel in permanent molds for the purpose of making shells. The added strength of this metal and the ease with which it can be brought to specifications in the open hearth, is certainly attractive. There is no doubt as to the suitability of steel for this work and it will readily pour in a permanent mold. Moreover, it is not hardened or weakened by the action of the mold. The grain is very fine and it yields exceptionally well to heat treatment. The main difficulty is that the process of casting in a permanent mold is a continuous performance, while the melting of steel in an open hearth is more or less intermittent. The steel when it comes from the open hearth must be poured without delay and after the metal in the ladle is poured, there must elapse an interval of hours before the next heat is ready. Furthermore, the economical melting of steel demands that it be made in furnaces of large tonnage and to pour this tonnage within the time limit within which the steel remains sufficiently molten to work, would require an immense number of molds and an elaborate and costly equipment to handle the ladles, operate the molds and take care of the castings. If the melting of steel can be economically accomplished, so that a continuous supply of molten metal is available, then the manifest advantage of steel over cast iron can be utilized.

When steel is cast in a permanent mold, an allowance must be made for shrinkage, as there is not the same initial expansion as is the case with cast iron. A greater bulk of mold must be provided to take care of the higher temperature and the gates, trap and runners must be given a coating of heavy clay wash after each pouring. This is necessary to prevent cutting the mold. A very slight under cut will put the mold out of business until repairs can be made. Once the "sting" of the molten metal is taken away by the runners, gates and trap, steel will do no harm to the matrix.

French Specifications

The French government has issued specifications for shells cast in sand that are here given in part. They call for the analysis of shells of 122 to 155 millimeters caliber. The chemical analysis is as follows:

	Per cent
Graphitic carbon	0.70
Combined carbon	2.40
Silicon	1.35
Manganese	0.70

The amount of total carbon and silicon must not exceed 4.7 per cent. If this limit is exceeded, the iron will lack toughness. At least 2 per cent of the total carbon must be combined to produce proper fragmentation. The percentage of dust increases as the combined carbon decreases.

Although the sum of total carbon plus silicon is set at 4.7 per cent, it is preferable to keep these limits to 4.4 per cent with a minimum percentage of silicon. The percentage of silicon varies according to the type of molding. In the 122-caliber the best results were obtained by using a minimum of 1.20 per cent silicon for dry sand and 1.35 per cent for green sand. The percentage of silicon varies in inverse ratio to the thickness of the walls and the caliber, the thicker the wall, and higher the caliber, the lower the silicon. Manganese decreases with the thickness of the walls and caliber and increases with the sulphur.

The sulphur should never exceed 0.08 per cent and should be lower whenever possible. The percentage of phosphorus is set at 0.15 per cent or under. The charge should be as follows:

	Per cent
Pig iron	40
Scrap	40
Steel	20

The term scrap is used to denote scrap melted, pigged and charged according to analysis.

These specifications correspond closely to the iron previously mentioned as being ideal for use in permanent molds. The striking point in the specifications is that the silicon decreases when a dry-sand mold is used, and this point is emphasized by the use of a still lower silicon in a permanent mold. The percentage of combined carbon will always be high when a permanent mold is used. Once the proper mixture has been determined, that mixture is used irrespective of the thickness of walls or caliber of shell.

All the foundries of France engaged in this work, have been mobilized on a common basis and are using precisely the same methods of selection, analysis and general foundry procedure. This has not been done without enormous losses and vexatious delays, there have been many cases where the loss of the total heat has been reported and a loss of 40 per cent was not uncommon in the first stages. Team work, scientific methods and keeping everlastingly at it, have brought results. Today the output has reached staggering proportions—over 1,000,000 rounds per day are being made.

Starting from the pig, the manufacture of a steel forging involves many operations and a huge outlay for equipment. The steel is made, poured into ingots, rolled into rounds, cut into blanks, heated to the forging temperature, pressed into the rough shape, pierced and run through a draw bench before the forging is ready for machining. A shell cast in a permanent mold and starting from the pig has but two operations—melting and molding. The heat treatment of the steel shell before machining is completed is balanced by the heat treatment of the cast-iron shell before machining.

A steel forging for a 4.7-inch shell costs over $7.00 at the present writing.

(*Concluded on page* 455)

FORMULAS FOR THE FOUNDRYMAN

A Flux for Soldering

When gated patterns become detached they may be replaced easily provided a good soldering fluid is employed. In making zinc chloride flux, the following precautions should be observed to obtain the best results:

Cleanliness is an important essential in making a good soldering fluid. The acid should be placed in a clean vessel, either glass or pottery. Metal containers should not be used as they are corroded by the acid, which contaminates the flux.

To make one gallon of soldering fluid use three quarts of commercial hydrochloric acid and place it in a suitable vessel; add zinc until the acid is *cut*. If the zinc is dirty it should be cleaned by dipping in acid and washing. Add the zinc to the solution, piece by piece, to prevent boiling over or the generation of sufficient heat to break the vessel if the latter is glass; stir the solution occasionally.

When the action between the zinc and acid has ceased, and no further bubbles appear when it is stirred, the solution should be filtered through several thicknesses of cloth tied over the mouth of a second jar to which the solution is transferred; this should have a capacity of at least one gallon. Add the following to the filtered solution:

(1)	Warm soft water	1 pint
	Sal-ammoniac	6 ounces

Add the sal-ammoniac to the water and stir until dissolved.

(2)	Warm soft water	1 pint
	Chloride of tin	4 ounces

Add the chloride of tin to the water and stir until dissolved, and mix the three solutions. The mixture will be slightly cloudy, and can be clarified by the addition of a small amount of hydrochloric acid, which should be added one drop at a time until the solution clears. This soldering flux will not spatter under the hot iron.

FORMULAS FOR THE FOUNDRYMAN

Soldering Aluminum Bronze

One great drawback to the extended use of aluminum bronze is the difficulty experienced in soldering the metal. This also applies to the tinning of the surface, so that this alloy cannot be used for articles that require the protection of a tin coating.

Copper Sulphate Flux

One method of soldering aluminum bronze employs a strong solution of copper sulphate as a flux. The parts to be soldered are immersed in the solution and are touched with an iron rod which produces a deposit of copper on the bronze. The parts are rinsed clean, when the coppered surfaces can be tinned and soldered. Instead of being coppered the surfaces can be nickeled, in which case it will appear that the bronze is really soldered.

The following flux, however, is more convenient as it permits the bronze to be coppered and soldered at one operation. Make the following solutions:

(1)	Dissolve dry copper carbonate	2 ounces
	Water	4 ounces
(2)	Hydrochloric acid	6 ounces
	Thin sheet iron	½ ounce

Let the iron stand in the acid over night, then gradually add solution No. 2 to solution No. 1. Add the acid slowly until effervescence ceases, and then add the rest rapidly. A clear green solution will result, to which is added 4 ounces of zinc chloride solution made as outlined in Data Sheet No. 243. This flux will deposit copper under the heat of the soldering iron to which the solder will adhere. The following solder should be used in connection with the flux:

	Per cent.
Tin	75
Lead	25

Melt together and run into convenient sticks.

THE FOUNDRY DATA SHEET, OCTOBER, 1917

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

Calculating Tensile From Transverse Strength

By W. J. Keep

Question:—Can tensile strength be calculated from the record of transverse strength?

Answer:—Thomas Box, in his "Strength of Materials," page 271, gives a formula for such a calculation, but he assumes that the neutral axis always is at the center of the test bar, which is true only for hardened tool steel and white iron. His formula follows:

$$T = \frac{W \times L \times 4.5}{[d - \sqrt{W \times L \times 4.5} \div (C \times b)]^2 \times b}$$

T = Maximum tensile strain on the extreme edge of the section, per square inch.
C = Maximum crushing stress on the extreme edge of the section, per square inch.
d = Depth of a rectangular test bar.
b = Breadth of the same bar.
L = Length of the same bar.
W = The transverse breaking load at the center of the bar.

This formula does not take into account the influence of the chemical elements in cast iron. "Strength of Materials" was published in 1888, before this influence was generally understood. This formula applies to steel and has been found to give reliable results.

In a tensile test the pull is supposed to be the same on all parts of the cross-section. In cast iron the grain is more open at the center of the section and, therefore, the outer grains are smaller and take more of the strain than those at the center. This open, center grain is produced by the silicon increasing graphite and is greater in a large section because the cooling is slower, giving the silicon a longer time in which to act. In any case, with cast iron, the outer portion is stronger than the center. With an even pull the central portions will stretch more and will throw the most of the load to the outside of the section. When the outer fibres give way, the central portion offers but little resistance.

Testing a similar bar transversely, at the instant of breaking, the leverage acting consists of a long arm equal to half of the distance between the supports and the short arm equal to the distance of the outer fibres from the neutral axis. The axis moves just as the bar breaks from the center of the test bar to a point near the outer fibres which are in compression. All of these conditions must be considered in a formula of this kind.

I made a machine which measured the amount of extension and compression on the outer fibres and it also gave the position of the neutral axis in a transverse test bar, 1 x 1 x 12 inches, also one 24 inches long. I made tests of tool steel, mild steel bars and of white cast iron and gray cast iron, containing varying percentages of silicon. I then developed formulas for the calculation of tensile and crushing strength from the records of transverse test bars and I constructed the accompanying table which gives a near approximation without the use of a special apparatus.

Measure the shrinkage per foot and the transverse strength of a test bar. If the test bars are longer, calculate the strength of a standard test bar, 12 inches long.

Referring to the table, find the measure of shrinkage of the size of the test bar used, or the silicon, as shown by analysis. Divide the transverse strength by the divisor for that size of bar as found opposite the shrinkage or silicon, to obtain the strength of a standard test bar, 1 inch square and 12 inches long. In the same horizontal line will be found the approximate value of *et* and *ec*. Then use the following formula for a test bar 1 inch square and 12 inches long:

$$T = \frac{4.5\ W}{et}$$

$$C = \frac{4.5\ W}{ec'}$$

$$W = \frac{T\ et}{4.5}$$

T = Tensile strength per square inch of a test bar cast and tested 1 inch square.
C = Crushing strength of the same bar.
W = Transverse strength of the same bar.
et = Distance of the neutral axis from the outer fibres in tension at fracture.
ec = Distance of the neutral axis from the outer fibres under compression at fracture.

Calculating Tensile From Transverse Strength

TABLE DEVELOPED BY MR. KEEP

	Silicon, per cent	Measured shrinkage per foot: ½ inch square	1 inch square	2 x 1 inches	Divisor to reduce strength to 1 x 1 x 12 inches of: ½ inch square to 1 inch square	2 x 1 inch to 1 inch square	Distance of neutral axis from outer fibre: et	ec
White cast iron	0 to 0.75	0.248	0.247	0.221	.....	.....	0.500	0.500
Mild steel.....	....	.....	.....	.....	.....	.....	0.518	0.481
Gray cast iron.	1.00	0.183	0.158	0.147	0.1473	1.857	0.550	0.450
Gray cast iron.	1.50	0.171	0.145	0.134	0.1567	1.819	0.580	0.420
Gray cast iron.	2.00	0.159	0.133	0.122	0.1648	1.787	0.610	0.390
Gray cast iron.	2.50	0.147	0.120	0.109	0.1713	1.757	0.640	0.360
Gray cast iron.	3.00	0.135	0.108	0.096	0.1772	1.717	0.670	0.330
Gray cast iron.	3.50	0.123	0.095	0.083	0.1839	1.704	0.700	0.300

Metallic barium was first obtained by electrolysis of the fused chloride, but later was made as follows: Sodium amalgam is added to a hot, saturated solution of barium chloride; the sodium displaces the barium which forms an alloy with the mercury, and the latter, which is barium amalgam, is kneaded with water to remove all the sodium. It then is heated in a stream of hydrogen to volatilize the mercury. Barium is a bright, yellow metal, with a specific gravity of 3.6. It fuses at a red heat, but does not vaporize.

Large Foundry to Produce Cast Steel Truck Wheels

A large foundry and machine shop to be devoted exclusively to the manufacture of cast steel truck wheels is being built by the Standard Steel Castings Co., Cleveland, which recently increased its capital stock from $125,000 to $1,000,000 to cover the cost of the extensive improvements and additions that are being made. The new plant will cost approximately $350,000 and the melting equipment of the foundry will include two 3-ton electric furnaces and three 2-ton side-blow converters. The output of the foundry will be 400 cast steel truck wheels per day or 1300 tons per month, making a combined tonnage of 2000 tons per month for the two plants operated by this company. The machine shop will have sufficient capacity to finish this large output.

The Standard Steel Castings Co. was incorporated in 1912. Its foundry is located on West Seventy-third street and the Big Four railroad and at present has an output of 350 tons of steel castings per month. This will be doubled before the end of the year. The product consists of automobile and miscellaneous castings weighing less than 200 pounds each. When the additions are completed the Standard company will have one of the largest foundries in the United States devoted to the manufacture of truck wheels. Officers of the company follow: Julius F. Janes, president; Edwin H. Janes, vice president and treasurer, and Wm. R. McDonough, secretary and general manager. In addition to the officers, the board of directors includes the following: E. W. Moore, P. J. Morgan, M. C. Rosenfeld, R. M. Calfee, J. C. Fogg and B. C. Tucker.

Tentative Specifications for Brass Castings

American Society for Testing Materials Proposes Specifications for Nonferrous Alloys for Railroad Equipment—Will Be Given Trial for a Year

NONFERROUS metals and alloys are engaging the attention of testing engineers to such an extent that specifications are being drawn for use of producer and consumer, which undoubtedly will result in a great improvement in brass foundry practice. At the annual meeting of the American Society for Testing Materials, held at Atlantic City, June 26 to 29, proposed tentative specifications for nonferrous alloys for railway equipment in ingots, castings and finished car and tender bearings were presented for consideration. This proposed standard will be given a trial for a year before it is presented for adoption. In the meantime criticisms are invited and these should be directed to William Campbell, chairman of the committee on nonferrous metals and alloys, Columbia University, New York. The proposed tentative specifications follow:

1. — (*a*) These specifications cover the various non-ferrous alloys for locomotive equipment in ingots, castings and finished car and tender bearings.

(*b*) These alloys and the purposes for which they are frequently used are as follows:

Bearing Metals No. 1 and 2, for connection rod bearings, bushings, eccentric straps, driving box bearings, trailer truck bearings, cross head gibs, hub liners and miscellaneous bushings;

Bearing Metals No. 3 and No. 4, for lead-lined bearings, for locomotive tenders, freight and passenger car equipment;

Bell Metal, for locomotive bells only;

Babbitt Metal, for babbitting driving boxes, rod brasses, cross heads and for hub liners.

Lining Metal, for lining truck brasses, tender brasses and car brasses.

CHEMICAL PROPERTIES AND TESTS

2.—(*a*) As shown in the accompanying table, the alloys shall conform to these requirements as to chemical composition, with the permissible variations specified.

(*b*) Where no figures are given for impurity maximum, these elements may be present up to any amount to come within the total impurity specified, providing the material otherwise meets the chemical and physical tests. Where maximum percentages are specified, the elements referred to are considered as impurities and shall not be intentionally added.

3.—An analysis will be made by the purchaser or his representative from one ingot, casting or journal bearing representing each lot. The chemical composition thus determined shall conform to the requirements specified in section 2 for the particular alloy.

4.—(*a*) *Ingots.*—Drillings shall be taken with a drill at least ½ inch in diameter at a point midway between the heaviest and smallest cross-section of the ingot. For ingots having two or more sections, drillings shall be taken from each section. In the case of babbitt metal and lining metal, drillings so taken shall be melted in a thoroughly cleaned ladle with a little rosin flux and poured into a piece of thin section. This piece shall be sawed into three parts and the sawings therefrom thoroughly mixed to constitute the sample for chemical analysis.

(*b*) *Locomotive Castings.*—Drillings shall be taken with a drill as large as possible at such points in the casting as shall be thoroughly representative. Drillings through the skin shall be rejected. Drlllings thoroughly mixed shall constitute the sample for chemical analysis.

(*c*) *Car and Tender Bearings.* — Drillings shall be taken with a drill at least ½ inch in diameter, at three points on the bearing selected for physical test as specified in Section 5 (*b*) as widely separated as possible. Drillings representing the skin of the casting shall be rejected. These drillings, thoroughly mixed, shall constitute the sample for chemical analysis.

Drillings shall be taken in a like manner from the lining, exercising care that the drill does not penetrate the soldered surface.

(*d*) All samples, whether taken with a drill or saw, shall be kept free of oil and shall be magnetized to remove iron introduced in taking the sample.

PHYSICAL INSPECTION AND TESTS

5.—(*a*) *Locomotive Castings.*—The castings shall be sound, free brom blowholes, flaws or shrinkage cracks, and shall show good foundry practice and workmanship.

One casting representing each lot of locomotive bearings will be broken by the purchaser or his representative for examination of fracture. The fracture shall disclose no shrink discoloration, segregation, dross or dirt spots within 5/8 inch of the bored journal engaging surface, and shall show no distinct signs of imperfect mixture.

(*b*) *Car and Tender Bearings.*—The bearings shall be sound, free from sand, blowholes, flaws or shrinkage cracks and shall show good foundry practice and workmanship.

One bearing representing each lot will be broken by the purchaser or his representative for examination of fracture. The fracture shall show no shrink discoloration, segregation, dross or dirt spots within ½ inch of the bored journal engaging surface. This test shall be made before linings are applied. A second test shall be made after applicaton of the lining as follows:

(1) The suspended brass when tapped with a hammer shall give a distinct ring.

(2) The lining when chipped with a cold chisel shall tear from the soldered surface as distinguished from clean shearing.

6. (*a*) *Ingots.*—Each 5000 pound or fraction thereof shall constitute a lot. The ingot from which the sample is taken shall be included in the shipment.

(*b*) *Locomotive Castings:*—Each 100 castings or fracton thereof unless otherwise specified shall constitute a lot.

The manufacturer shall furnish, free of cost, one casting representing each lot for purpose of tests as specified in Sections 4 (*b*) and 5 (*a*).

(*c*) *Car and Tender Bearings.*—Each 300 bearings or fraction thereof, unless otherwise specified from each pattern shall constitute a lot.

The manufacturer shall furnish, free of cost, one bearing representing each lot for purposes of tests as specified in Sections 4 (*c*) and 5 (*b*).

PERMISSIBLE VARIATIONS IN DIMENSIONS

(For Car and Tender Bearings Only.)

7.—(*a*) The purchaser will furnish drawings showing the dimensions of the bearings ordered and permissible variations therefrom and the bearings shall conform to these drawings within such permissible variations.

(*b*) The thickness at the center of the brass and of the complete bearing shall not vary more than 3/32 inch over or under the normal thickness shown on the drawing. The thickness of the lining shall not vary more than 3/32 inch over or under the normal thickness shown on the drawing.

WORKMANSHIP

8.—(*a*) *Locomotive Castings.*—The castings shall conform to the dimensions specified and shall show good workmanship generally.

(*b*) *Car and Tender Bearings.*—The bearings shall show good workmanship generally, and shall be free from mechanical imperfections. They shall be bored to a true radius, and with the axis parallel to the plane of the top and perpendicular to the side lugs and bearing flange. The lettering shall be clear and distinct. No emery shall be used on journal engaging surfaces on either the brass or the lining.

MARKING

9. (*a*) *Ingot.*—The manufacturer's marking only shall be required, unless otherwise specified.

(*b*) *Locomotive Castings.*—The lot number and other marks as required by the drawings

Proposed Tentative Specifications

Alloy.	Copper, per cent.	Lead, per cent.	Tin, per cent.	Zinc, per cent.	Iron, max., per cent.	Anti-mony, per cent.	Phos-phorus, max., per cent.	Alumi-num, per cent.	Sul-phur, max., per cent.	Total impurity, excluding Zinz, per cent.
Bearing Metal No. 1	remainder	9-11	9-11	1.5*	0.4	0.5*	....	none	....	1.0
Bearing Metal No. 2	remainder	7-9	14-16	1.5*	0.4	0.5*	....	none	....	1.0
Bearing Metal No. 3	remainder	7-9	14-16	3.0*	0.4	0.5*	....	none	....	1.0
Bearing Metal No. 4	remainder	4-6	15-20	5.0*	0.4	0.5*	....	none	....	1.0
Bell Metal	remainder	16-18	0.25*	0.25*	0.25	0.25*	0.02	none	0.05	0.5
Babbitt Metal	0.5*	9-11	rem'dr	0.10*	0.05	15-17	....	none	....	0.75
Lining Metal	0.5*	4-6	rem'dr	0.10*	0.05	9-11	....	none	....	0.75

*Maximum.

shall be legibly marked on each casting.

(*c*) *Car and Tender Bearings.*—The name or initials of the manufacturer, the initials of the purchaser, type number, journal size, and lot number shall be legibly cast with raised figures on a depressed surface of each bearing, as shown on drawings.

INSPECTION AND REJECTION

10.—(*a*) Inspection may be made at the manufacturer's works where the ingots, locomotive castings or car and tender bearings are made, or at the point at which they are received, at the option of the purchaser.

(*b*) If the purchaser elects to have inspection made at the manufacturer's works, the inspector representing the purchaser shall have free entry at all times while work on the contract is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

11.—Failure to meet the chemical or physical specifications, or non-conformity to any of the above requirements as to permissible variations, dimensions and markings, constitute sufficient cause for rejection of the lot represented by the sample chosen.

Experiments With Sulphur in Copper

To ascertain the effect of the addition of sulphur to copper, the following interesting experiment was made: A small heat of copper was melted and when ready to pour, was treated with 1 per cent of roll sulphur. The metal was poured into a sand mold in the form of an elongated bar, 1 inch square. After the mold was filled, the head of the sprue ejected copper in the form of a spray accompanied by a buzzing noise. The head did not rise, but sank in the center and its circumference adjacent to the sand was efflorescent.

The casting was dark-colored externally and contained dirt or slag on the cope side, together with very fine, shallow pin holes. The fracture of the bar showed fibers arranged axially from the center. When the bar was broken, the fibers tore and gave the fracture the appearance of a flower. The center of the fracture was solid and dull red in color. The fibers which radiated from the center were bright, and near their outer end were sprinkled with fine, bright specks which probably were minute holes.

In the second experiment, a heat of electrolytic copper was treated with 1 per cent sulphur and 1 per cent of copper oxide. The casting, when poured, sprayed vigorously. The pouring head swelled badly and it resembled a cauliflower. When setting, the copper emitted a crackling noise. The bar only weighed two pounds, while the weight of the sulphur treated bar made from the same pattern was 2¾ pounds.

Externally, the casting was black and dirty; internally, the fracture was comparatively sound around the edges in contact with the sides of the mold. The center of the bar was honeycombed, the interiors of the cavities being as brilliant as if burnished. Compared with the sulphur-treated bar, the fracture was a deep red, which probably was due to the presence of nonovide of sulphur. When cast both bars emitted fumes of sulphur dioxide, but in the oxygen-treated bar the fumes were much more pronounced.

These experiments are of considerable interest in view of the fact that sulphur has been proposed as a deoxidizing agent in the sand-casting of copper. Unfortunately, however, this element has too great a chemical affinity for copper to be of service in this connection.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

A Non-Shrinkable Pattern Alloy

We would like a formula for a non-shrinkable pattern metal that will be lighter than the usual lead base alloys used for this purpose.

A non-shrinkable pattern metal is unknown, since all metals and alloys diminish to some extent in volume when changing from the liquid to the solid state. However, some alloys shrink less than others and one that is noted for its low shrinkage and which is used largely for making white metal patterns, follows: Zinc, 50 per cent, and tin, 50 per cent.

Core Sand Mixture for Globe Valves

We would like to have a good core sand mixture for globe valves weighing from 50 to 200 pounds.

The following mixture will serve your purpose: Old molding sand, 33 parts; new molding sand, 33 parts, and sharp sand, 33 parts. For each 35 parts of sand add one part of any linseed core oil. Wet with water to the proper consistency.

Another mixture consists of one-third each of new molding sand, old floor sand and sharp sand. For 80 parts of sand, add one part of dextrine for small cores, but reduce the percentage of dextrine for large cores.

Avoiding the Cutting of Cores

In producing heavy brass castings we are experiencing difficulty with the cores, since the metal cuts into them to such an extent that it is almost impossible to extract them from the castings. We have tried different core sand mixtures and have changed from an open to a close grade sand, without obtaining satisfactory results. Also linseed oil has been used as a binder in place of some of the other binding materials with which we have experimented.

Bronze that is heavily phosphorized will penetrate any core if it is poured hot and if the core is not protected externally by some infusible coating. In this case, linseed oil should be satisfactory as a binder. The same method of making the core should be continued and a large amount of sharp sand should be used so that the cores will be free and open. Make a mixture of a good grade of plumbago and molasses water, using this for a blacking to coat the cores. Next, mix the plumbago with a small amount of weak molasses water, sufficient to make a paste and rub this onto the core with the fingers and polish it until it shines. Leave no part of the core uncovered and have it quite warm when it is set into the mold, pouring before the metal cools. If these suggestions are followed, we believe your difficulty will be overcome.

Cause of Flaking

We use steel tubing in the manufacture of a machine. Some of the tubes are drawn tapering while others are flattened. These operations heretofore have been carried out before the tubes were copper-plated, but to reduce the cost we desire to copper them previous to drawing or shaping. We have used a cyanide copper solution for first coating, followed by a one hour acid copper de-

posit. While apparently satisfactory on the pieces formed before plating, we find that the deposit cracks and peels off the pieces we have plated before forming, the treatment evidently being too severe. Do you think a suitable solution can be prepared for our purpose at a nominal cost, or is the treatment unreasonable for a heavy depoist?

The difficulty as described may be the result of two causes. If the deposit cracks and breaks off in flakes from the cyanide copper deposit, the trouble is undoubtedly caused by insufficient acid in the solution. In this case we would advise gradually adding more acid until the deposit is sufficiently tough when deposited with a current density of 15 or 20 amperes per square foot; then if the surface of the tubes is rough, add one ounce of black molasses to every 25 gallons of copper solution. A deposit from this solution should withstand even more severe treatment than you mention. If the entire copper deposit actually peels in ribbons from the tubes, the cause is an unclean steel surface or incorrect conditions when using the cyanide copper bath.

Rough and Dirty Yellow Brass Castings

We are sending you a brass casting which you will note is rough and dirty on the surface and we would like to have your opinion for overcoming this difficulty. This casting must buff to a perfect finish. We will appreciate any suggestions on gating and pouring or on any other subject that will enable us to get castings free from pits.

An examination of the casting indicates that the metal is yellow brass, and the cause of the difficulty is unskillful pouring. The castings also are gated improperly. The pits which mar the entire surface of the casting are caused by the entrance of zinc oxide into the mold. There are several ways of overcoming the difficulty that might be suggested, but judging from the manner in which this casting is gated and poured, we believe the most economical way would be to change the alloy to a red brass. The first cost might be higher, but the ultimate saving would outweigh this consideration. We suggest the following alloy: Copper, 86.50 per cent; zinc, 6.50 per cent; tin, 3.50 per cent, and lead, 3.50 per cent. The castings should be gated on the heavy section about ½-inch from the piece that projects at right angles to the main casting; or, if this is inconvenient, the gate may be placed directly on the end opposite the point where it was placed on the casting submitted.

Minute Cavities in Brass Castings

We are experiencing considerable difficulty in manufacturing small brass castings. When the surfaces of these castings are machined, it seems as if the metal is torn away from the minute cavities by the tools. The mixture consists of copper, 82 per cent; tin, 10 per cent; lead, 8 per cent, and 5½ pounds of 15 per cent phosphor copper.

Your trouble may be attributed to any one of a number of causes and, therefore, a process of elimination will be necessary in order to ascertain the remedy. This difficulty may be due to the overoxidation of the metal or burning during the melting process. The remedy for this would be to use a fusible flux which, with the charcoal, will form a thick, tenacious cover over the metal as it melts. A cover for this purpose is fusible glass.

Also, your trouble may be caused by the exudation, as the metal solidifies, of a rich alloy of phosphorus, copper and tin, minute globules of which are comparatively hard and brittle and are torn out by the tools in machining. The remedy would be to lower the phosphorus content. However, we doubt whether this is the cause and we are inclined to believe that it is due to overoxidation.

It is possible, also, that your trouble may be due to the reaction between the chemical constituents of the alloy; to the moisture and the silica content of the sand or to some facing which you are using to protect the mold. A mold coated with silica wash is excellent for casting steel, but when used with phosphor bronze would produce spongy castings. We suggest the use of a coating of the best graphite obtainable; also, if possible, to reduce the phosphor copper to 0.5 per cent; it would be advisable to do this even if a slight increase has to be made in the tin content to obtain the necessary hardness.

Cleaning Brass Castings With Acid

Kindly let us know how to clean brass castings by the acid process.

For removing the sand from brass castings the following dip is widely used: Muriatic acid, 6 gallons; nitric acid, 1 gallon, and water, 2 gallons. The castings can remain in this dip for about 30 minutes until the sand falls off, when they are removed and rinsed in running water after which they are re-dipped in the following solution: Nitric and sulphuric acids, 1 gallon each, and salt, 1 ounce. To mix the acids, place the nitric acid in a strong crock into which the sulphuric acid is gently poured and great care should be exercised not to spill either of the acids. This solution should be mixed the day before it is to be used to give it plenty of time to cool before the castings are dipped. The mixing should be done out of doors, or under a hood connected to a chimney with a good draft. After the castings are dipped, they should be rinsed in cold water, followed by rinsing in hot water, after which they are dried in sawdust. To a large extent, the sand-blast has replaced the acid cleaning method.

Can Government Metal be Forged?

We would like to know whether government metal can be forged, and if so, will you kindly give us the process?

The metal made from the formula of copper, 88 per cent; tin, 10 per cent, and zinc, 2 per cent, is the one to which you refer and so far as we can ascertain, this alloy has never been forged, since it is so brittle that it would crumble at a red heat. For forging purposes, we suggest the use of manganese or aluminum bronze. If manganese bronze is selected, it is customary to omit the aluminum which always is added to make this metal run better in sand castings. If aluminum bronze is preferred, melt 90 pounds of copper and 10 pounds of aluminum, stir thoroughly to secure a uniform composition and pour it at a medium temperature.

Removing Aluminum From Brass

Can aluminum be removed from brass? Our scrap consists of yellow brass castings made for automobiles, which contain a high percentage of aluminum.

Aluminum may be removed from copper alloys by oxidation, but unfortunately this is not a satisfactory process for yellow brass as the zinc, in addition to the aluminum, is lost. This is due partly to the high temperature generated by the oxidation of the aluminum which volatilizes the zinc, and also to the fact that the two metals oxidize as an alloy of aluminum and zinc. Therefore, it usually is necessary to remove all of the zinc to set free the aluminum, leaving only the copper.

The automobile castings to which you refer are manganese bronze, but if the scrap is heavy and is carefully sorted most of the manganese bronze can be removed and can be used for other purposes for which it is best adapted. Also, it can be mixed with red or yellow brass in the proportion of 5 or 10 per cent, keeping the amount just below the percentage at which the aluminum would show in the castings. This can be determined by experience. The method outlined is the most practical method devised for using this material.

Producing Machinable Malleable Iron Castings

Hard Iron, Underannealed Iron and Burned Iron Cause Trouble in the Machine Shop—Difficulties Easily Avoided by Intelligent Investigation

By A T Jeffery

THE advent of the automobile with the subsequent use of large quantities of malleable castings in its construction opened up a new line of troubles for the malleable manufacturer, with all of the old troubles seriously magnified. High-speed machinery puts malleable iron to a very severe test and the very best quality is not any too good for this purpose. Any product containing iron-carbide will be found unsatisfactory under these conditions.

White iron with its large percentage of iron-carbide will destroy the most costly tools just as quickly as it will the cheaper grades. In many cases it causes a delay of several hours, holding up the production of an expensive machine. Similar results, although perhaps to a lesser degree, will result from machining any iron containing even a small percentage of combined carbon. Iron with pearlitic rim will spring machine tools causing them to give oversize dimensions, making necessary a second operation. Iron with a thick decarbonized rim will clog the teeth of milling cutters and push ahead of a lathe tool that is properly ground for machining ordinary malleable.

Five Varieties Cause Trouble

There are five distinct varieties of iron from which one or more of these complaints may arise. They include pure, hard white iron, underannealed iron, iron cooled too quickly, burned iron and iron that is sometimes called hard but is really tough and stringy.

Pure, hard white iron cannot get into the machine shop except through carelessness. It is very easily recognized by an expert, although to the uninitiated and under ordinary conditions it may be confused with under-annealed iron. The only remedy for pure white iron in the machine shop is care that hard and soft iron shall not be allowed to come in contact with each other or cross each other's path in passing from one department to another.

Under-annealed iron may be in two states, first as shown in Fig. 1, not affected by the heat of the annealing furnace. In this condition it has practically the same qualities as pure white iron except that initial strains due to cooling from the molten state have been removed. The second state is shown by Fig. 2. This iron will give all kinds of trouble in the machine shop. It will wear machine tools very rapidly, cause them to heat and will also strain the jigs and chucks unless they are massive and designed with a large factor of safety. It will show a black fracture when broken and cannot be detected except by chemical or preferably by microscopic analysis. It has little ductility and only slight resistance to shock.

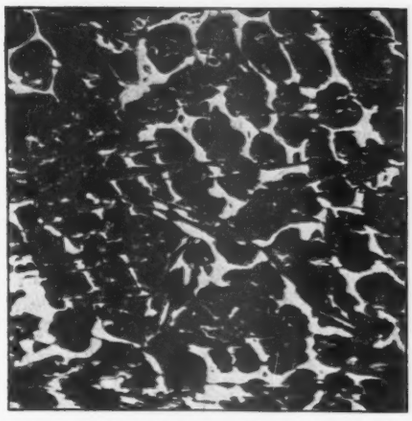


FIG. 1—MICROGRAPH OF WHITE IRON SHOWING FREE CEMENTITE IN WHITE AREA—DARK AREA IS PEARLITE

Either state of under-annealed iron is caused by lack of proper heat treatment. Annealing ovens with bad circulation, too large annealing pots or lack of proper knowledge or facilities for reading temperatures are the usual underlying causes. They are to be remedied by a scientific study of draft conditions, size and spacing of pots and the installation of adequate and reliable pyrometers. Large pots jammed tightly together forming nearly a solid mass of iron can heat only by the conduction of heat from the exposed tops, which must be at a considerably higher temperature than is necessary to anneal properly, in order to produce a flow of heat to the less exposed parts. There is thus a tendency toward false pyrometer readings of the actual temperature of the coldest part of the oven, the inside of the pot. There will be very little circulation of hot gases around the pots and they will go to the outlet that offers the least resistance and is the most direct. The outlets for gases should be so placed that the gases will be forced to come in contact with all parts of the oven and the intensity of the draft should be measured and gaged to insure a proper quantity of heat reaching every pot.

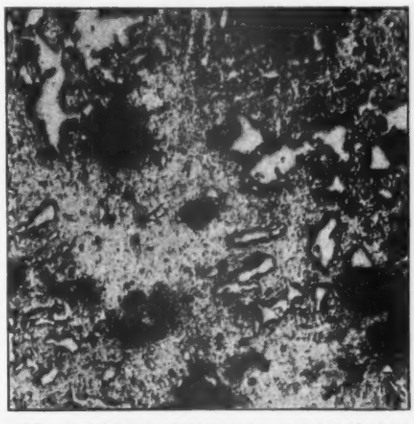


FIG. 2—UNDER-ANNEALED IRON SHOWING SOME FREE CEMENTITE

Test Lugs Are Useful

As a check on the efficiency of the heat treatment, test lugs should be placed on all castings. They should be broken by hammering and the quality of the iron determined. In the case of small castings at least one should be broken from the center of the bottom of each pot. There will be no trouble from under-annealed iron in the machine shop if these suggestions and precautions are carefully heeded.

One of the most aggravating troubles for the machinist is caused from iron with a pearlitic rim, as shown in Fig. 3. It will lead the machinist to register a vigorous kick and yet under ordinary tests the cause cannot be detected and the average observer will pronounce the iron good. The iron very likely will bend well when hammered and the fracture will be black except for the usual compression edge seen in all black heart malleable. Such iron, however, will wear and spring the machinist's tools and his verdict will be "hard iron." When subjected to the microscopic test, however, by a trained observer the trouble is easily determined; usually it is caused by too quick cooling. This has not caused it to be entirely returned to the white iron state and will not unless

A paper read at the Boston meeting of the American Foundrymen's Association. The author, A. T. Jeffery, is assistant superintendent, Dayton Malleable Iron Co., Dayton, O.

FIG. 3—IRON COOLED TOO QUICKLY, SHOWING PEARLITE IN DARK AREAS

the cooling is done at a very rapid rate.

Quick cooling is nearly always the result of carelessness or lack of knowledge of the consequences. Iron cooled faster than 20 degrees per hour will be in the danger zone. Bad dampers controlling the draft, fire and ash pit doors left open, cracked or leaky walls and removing the doors from the oven too soon will cause this trouble. A crack in the ash pit wall where the fire is above the floor line of the oven will furnish enough cold air to chill adjacent pots. The remedy is obvious. First, however, an educational program must be instituted, because workmen in charge of the annealing generally do not understand the detrimental features resulting from little acts of carelessness in looking after this part of their work. They are in the habit of judging from fracture and therefore do not detect anything serious when a piece of iron cooled too quickly is broken.

Burned iron affects the machinist in about the same manner as hard or annealed iron. It is perhaps a little more easily drilled and with very powerful tools may be machined. However, what has been said about hard iron will fit here also. Fortunately for the malleable manufacturer, burned iron is rare except as it creeps in at the tail end of a cast unobserved to be discovered later and laid at the door of the annealing oven when its identity is not fully ferreted out and properly accounted for. I am considering here as burned, that iron in which certain elements have been too far removed to allow the breaking up of the iron carbide in the annealing furnaces. Except in very rare cases it is not seriously damaged as far as its properties are concerned, although in those rare cases it will take on a honeycombed appearance and become absolutely useless except for remelting.

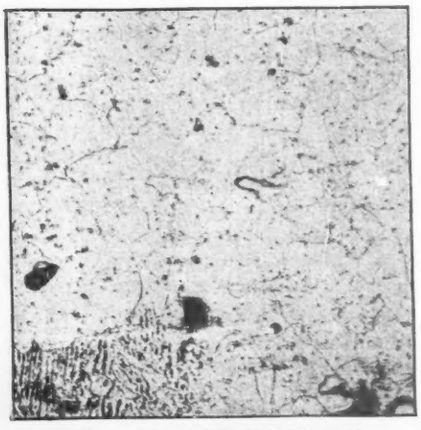


FIG. 4—DECARBONIZED RIM

If either the carbon or silicon is too much reduced in the melting furnace, iron will be produced that cannot be annealed, under ordinary conditions. Iron too low in silicon can be obtained by error in calculating the mixture, mistake in the chemical laboratory analyzing the pig iron or by excessive oxidation in the melting furnace. Manufacturers using a low-silicon, high-carbon mixture are most liable to encounter this condition. Error in the calculation of the mixture needs no comment; it is the result of carelessness or may be due to entrusting this work to an incompetent man.

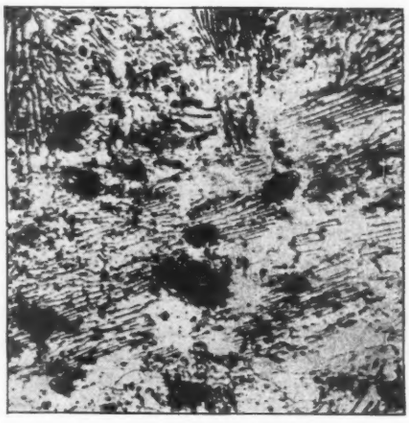


FIG. 5—FRAME OF PEARLITE

Bad chemical analyses may often be laid at the door of the blast furnace people, some of whom have had the honesty to admit that their analyses may be as much as 20 per cent off either way. The best way to eliminate this evil is to analyze each car of iron and use more than one car or kind of pig iron in the mixture, trusting in the law of averages to keep within proper limits. A furnace that is oxidizing rapidly will finish the job if the conditions mentioned are not watched; a sleepy fireman with holes in his fire or too much blast coupled with bad furnace practice will increase the danger. A well practiced eye aided with long experience in taking tests under standard conditions will help materially when low silicon is encountered because the eye will detect the trouble and our old friend ferrosilicon may be added to bring up the silicon content to the required amount.

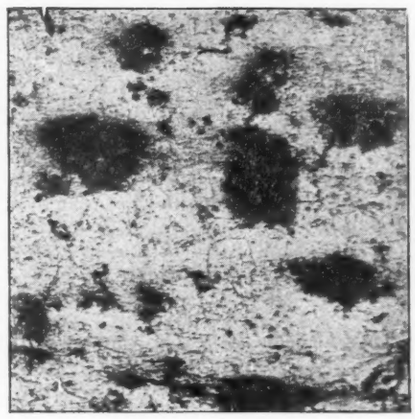


FIG. 6—CORE INSIDE OF FRAME

Carbon plays just as important a part as silicon and may or may not be low enough to give trouble when the silicon is low. When one considers that the best malleable is made with carbon hovering near 2.30 per cent and that 2.20 per cent is decidedly in the danger zone with ordinary malleable mixtures, also that pig iron may vary as much as 1 per cent in carbon, then one must prepare for trouble if he attempts to make low-carbon iron in large quantities with several furnaces running. Carbon is subject to about the same amount of oxidation as silicon under the same conditions, the only difference being that it cannot be replaced as readily. Therefore it behooves the most of us to play safe on carbon, at the same time protecting the machine shop from hard iron and also from semi-gray iron.

Last but not least of the sources of complaint from the machine shop is iron that bears the name of being hard but really is too soft and tough to machine readily. Most machine hands have had trouble at one time or another machining very good wrought iron. It pushes ahead of the tool and causes excessive chattering and wear, making necessary an extra cut, and in case the machine tool is weak it will jump out of the holding fixture and

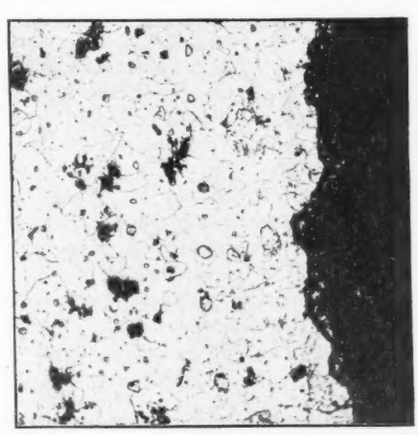


FIG. 7—DECARBONIZED RIM OF TOUGH MALLEABLE IRON

seriously strain the machine. The outside rim of extra-good malleable resembles the best wrought iron and closely rivals it all through the section. Its chemical make-up as far as iron is concerned is the same except that the particles of slag worked-in in wrought iron are replaced with particles of temper-carbon in malleable iron, as shown in Fig. 7.

Manufacturers of malleable iron should refuse to take this kind of iron back as foundry scrap. They should demand that the user provide sufficiently strong machine tools, run at such speeds as to readily care for this iron. The writer had occasion recently to inspect castings returned for being hard that had been drilled in several places and tapped in others without any apparent difficulty but upon boring a 12-inch dimension, the tool had evidently refused to cut. Microscopic analysis showed good, normal malleable, but upon investigation it was determined that the machining was done on an ordinary drill press using a boring bar in place of a drill running at high speed. The best of high-speed steel was used. On the other hand, a certain well-known manufacturer uses such sturdy machines that a chattering tool is rarely heard in the entire shop and when a casting is returned for being hard there is no doubt about the fact that it is hard. Of course, these are two extreme cases, but they serve to illustrate my point.

The malleable manufacturer can eliminate all trouble from this source by making relatively high-carbon iron, annealing it in nearly inert packing, producing iron that perhaps will pass as malleable. But at the same time he will be wandering away from the best practice and will not add to the reputation of the industry, which has suffered in the past from just such weak-hearted practice.

Summary

In summarizing, it may be said that the fundamental or underlying cause of trouble with malleable iron in the machine shop is generally due to a lack of scientific study of the material in question along practical lines and to the lack of active co-operation by the users of malleable iron. Designing engineers have neglected to familarize themselves with the properties and peculiarities of malleable iron due largely to the meager amount of authoritative information in print, and their unwillingness to accept the statements of men who are well informed but are perhaps unable to express themselves fluently and who are the operative heads of our best malleable foundries. In many instances bad designs are changed with reluctance, although the engineer is becoming more alive every day to the advantage and necessity of close co-operation with the practical man in the foundry. As in other spheres, therefore, *co-operation* should be our watchword and with intelligent effort and hearty co-operation between producer and user, most of our troubles will disappear.

Ladle Sleeves and Stoppers

Safety Standards Recommended at Boston Meeting of American Foundrymen's Association Adopted

ONE of the most interesting reports submitted at the Boston meeting of the American Foundrymen's association was that of the committee on steel foundry standards. This report, which recommends new standards for ladle sleeves and stoppers was unanimously adopted. The report in full is as follows:

"During the past year, the committee on steel foundry standards selected as its problem for investigation the standardization of standard sleeves, special sleeves and graphite ladle stopper heads, all of which is a sequel to the report on the standardization of ladle nozzles submitted at the Chicago convention in 1914.

"The standardization of ladle nozzles has been of inestimable value to both users and manufacturers. In these stirring times of top-notch production, the assurance of being able to obtain a standard product, rather than to have to wait for the manufacture of special designs has been a source of incalculable value and satisfaction.

"The committee, this year, proceeded much along the same lines as the original committee, obtaining an expression from 30 or 40 steel foundries indicating their practices. We found widely diversified opinions as to what constitutes good practice in stopper-rod equipment design. We also found that in some instances this all-important function of ladle equipment has received little or no consideration.

"We found, in general, that the thickness of the walls at the base of the special sleeves is insufficient. With the varying degrees of burning on the part of the sleeve manufacturers, this thin wall is often underburned and very fragile, causing disintegration at the temperature of molten steel. This permits the steel to find its way to the stopper-rod pin, often resulting in the loss of a stopper head. We also found that many foundries use a stopper head with only a short wall offset of ⅜-inch. We believe this dimension should be increased to 1⅝ inches to secure a better fit between stopper head and sleeve and a better alignment of the stopper head with the rod.

"We also found that the dimension for the insert of the stopper head and the recess of the special sleeve was the same. To safeguard against variations in depth and unevenness in the bearing faces of the recess of the special sleeve, we have recommended that the depth of the recess be made ⅛-inch greater than the height of the stopper head insert. To make it certain that the total stress and shock will not be carried by the shoulder of the stopper head, we would

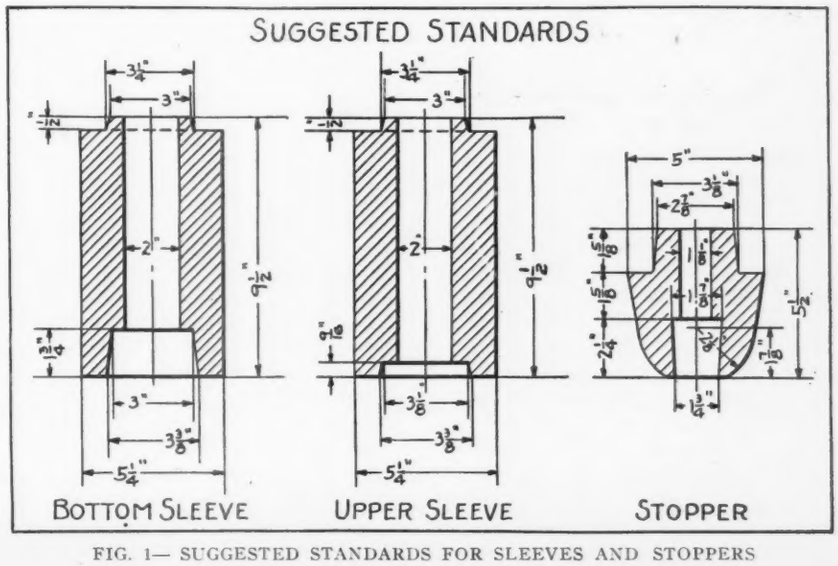
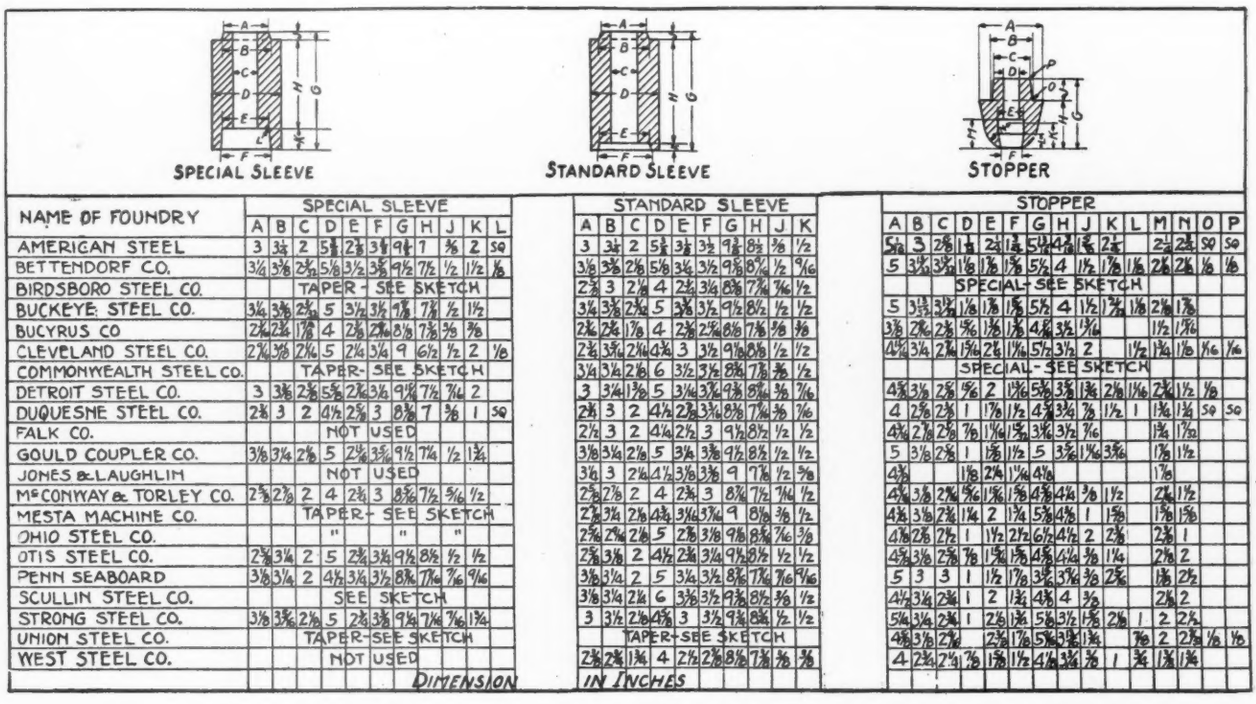


FIG. 1— SUGGESTED STANDARDS FOR SLEEVES AND STOPPERS



NAME OF FOUNDRY	SPECIAL SLEEVE											STANDARD SLEEVE										STOPPER														
	A	B	C	D	E	F	G	H	J	K	L	A	B	C	D	E	F	G	H	J	K	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P
AMERICAN STEEL	3	3¼	2	5⅛	2⅜	3½	9⅛	1	⅜	2	SQ	3	3¼	2	5⅛	3⅜	3½	9⅜	8½	⅜	½	5⅛	3	2⅜	1⅜	2⅜	1⅜	5⅛	4⅛	1⅜	2½		2½	2½	SQ	SQ
BETTENDORF CO.	3⅛	3⅜	2⅜	5⅛	3½	3⅝	9½	7½	½	1½	⅛	3⅛	3⅜	2⅜	5⅛	3¼	3½	9⅜	8¼	½	9/16	5	3⅛	3⅜	1⅛	1⅜	1⅜	5½	4	1½	1⅜	1⅛	2⅛	2⅜	⅛	⅛
BIRDSBORO STEEL CO.	TAPER - SEE SKETCH											2⅜	3	2⅛	4	2⅜	3¼	8⅜	7⅛	⅞	½	SPECIAL - SEE SKETCH														
BUCKEYE STEEL CO.	3¼	3⅜	2⅜	5	3½	3⅝	7⅜	7½	½	1½		3¼	3⅜	2⅜	5	3⅜	3½	9½	8½	½	½	5	3⅛	3⅜	1⅛	1⅜	1⅜	5½	4	1½	1⅜	1⅛	2⅛	1⅜		
BUCYRUS CO	2¾	2¾	1⅞	4	2⅜	2⅞	8⅛	7⅜	⅜	⅜		2¾	2¾	1⅞	4	2⅜	2⅝	8⅛	7⅜	⅜	⅜	3⅜	2⅜	2⅜	1⅝	1⅛	1⅜	4⅜	3½	1⅜			1½	1⅜		
CLEVELAND STEEL CO.	2¾	3⅜	2¼	5	2¼	3¼	9	6½	½	2	⅛	2⅜	3¼	2¼	4⅜	3	3½	9⅛	8⅛	½	½	4⅛	3¼	2¼	1¾	2⅛	1⅜	5½	3½	2		1½	1¾	1⅛	1/16	1/16
COMMONWEALTH STEEL CO.	TAPER - SEE SKETCH											3¼	3¼	2⅛	6	3½	3½	8¾	7⅜	⅜	½	SPECIAL - SEE SKETCH														
DETROIT STEEL CO.	3	3⅜	2⅜	5⅜	2⅜	3¼	9⅛	7½	¾	2		3	3¼	1⅞	5	3¼	3½	9⅜	8¼	⅜	7/16	4⅜	3½	2⅜	1⅜	2	1⅜	5⅛	3⅜	1⅜	2⅛	1⅜	2⅛	1½	⅛	
DUQUESNE STEEL CO.	2⅜	3	2	4½	2⅜	3	8⅜	7	⅜	1	SQ	2⅜	3	2	4½	2⅜	3⅛	8⅜	7⅛	⅜	⅜	4	2⅜	2⅛	1	1⅞	½	4½	3½	⅞	1½	1	1⅜	1½	SQ	SQ
FALK CO.	NOT USED											2½	3	2	4½	2½	3	9½	8½	½	½	4½	2⅞	2⅞	⅞	1⅛	½	5	3⅜	⅞	1⅜		1⅜	1⅞		
GOULD COUPLER CO.	3⅛	3¼	2⅛	5	2⅛	3⅜	9½	7¼	½	1⅜		3⅛	3¼	2⅛	5	3⅛	3⅜	9½	8½	½	½	5	3⅛	2⅜	1	1⅜	1½	5	3⅜	1⅛	3⅜		1⅜	1½		
JONES & LAUGHLIN	NOT USED											3¼	3	2¼	4½	3⅛	3⅜	9	7⅛	½	⅝	4⅝			1⅛	2¼	1¼	4⅛					1⅞			
McCONWAY & TORLEY CO.	2⅝	2⅜	2	4	2⅜	3	8⅜	7½	⅝	½		2⅝	2⅞	2	4	2¾	3	8¾	7½	⅞	½	4⅜	3⅛	2⅛	5/16	1⅛	1⅛	4⅜	4⅛	⅜	1½		2⅛	1½		
MESTA MACHINE CO.	TAPER - SEE SKETCH											2⅞	3¼	2⅛	4¾	3¼	3¾	9	8⅛	⅜	½	4⅜	3⅛	2⅛	1¼	2	1¼	5⅛	4⅛	1	1⅝		1⅞	1⅝		
OHIO STEEL CO.	"			"								2⅝	2¾	2⅛	5	2⅜	3⅛	9⅛	8⅜	⅞	⅜	4⅜	2⅜	2½	1	1½	2½	6½	4½	2	2⅜		2⅜	1		
OTIS STEEL CO.	2⅝	3¼	2	5	2¼	3¼	9½	8½	½	½		2⅝	3⅛	2	4½	2¾	3¼	9½	8½	½	½	4⅜	3⅛	2⅝	⅞	1⅝	1⅝	4⅝	4¼	⅜	1¼		2⅛	2		
PENN SEABOARD	3⅛	3¼	2	4⅜	3¼	3½	8⅝	7⅞	⅞	9/16		3⅛	3¼	2	5	3¼	3½	8⅝	7⅞	⅞	9/16	5	3	3	1	1½	1⅞	3⅝	3½	⅜	2⅝		1⅜	2½		
SCULLIN STEEL CO.	SEE SKETCH											3⅛	3¼	2⅛	6	3⅜	3½	9⅜	8½	⅜	½	4½	3¼	2⅜	1	2	1⅜	4⅜	4	⅜			2⅛	2		
STRONG STEEL CO.	3⅛	3⅜	2⅛	5	2⅛	3⅜	9¼	7⅛	⅞	1¾		3	3½	2⅛	4⅜	3	3½	9⅜	8⅜	½	½	5⅛	3¼	2⅜	1	2⅛	1⅜	5⅛	3½	1⅜	2⅛	1	2	2½		
UNION STEEL CO.	TAPER - SEE SKETCH											TAPER - SEE SKETCH										4⅜	3⅛	2⅜		2⅜	1⅞	5⅛	3⅜	1⅜		⅞	2	2⅛	½	⅛
WEST STEEL CO.	NOT USED											2⅜	2¾	1¾	4	2½	2⅜	8⅛	7⅛	⅜	⅜	4	2¾	2¼	⅞	1⅜	1½	4¼	3¾	⅜	1	⅜	1⅜	1⅜		

DIMENSION IN INCHES

FIG. 2—DIMENSIONS OF SLEEVES AND STOPPERS IN USE AMONG VARIOUS FOUNDRIES

suggest that a wadding or filler of clay be inserted between the top of the stopper head and the bearing face of the special sleeve.

"We realize full well that the recommended standards are quite a departure from the past practices of many foundries. We, however, urgently solicit the trial and co-operation of all foundries in their adoption and use. Your committee has made no recommendations or specifications covering the character of the clay composition or the degree of burning. The refractory manufacturers are more familiar with the nature of their raw material and the required burning than we are.

"A table covering a survey of the practice of various steel foundries and sketches showing the recommended standards is presented herewith."

Mixture for Stove Castings

By W. J. Keep

Question.—We would like to have an economical mixture for stove plate castings.

Answer.—The following analysis fairly represents American stove plate practice: Silicon, 2.77 per cent; sulphur, 0.076 per cent; phosphorus, 0.82 per cent, and manganese, 0.59 per cent. A range in the percentages of the elements is given in the following: Silicon, 2.25 to 2.75 per cent; sulphur, under 0.08 per cent; phosphorus, 0.60 to 0.90 per cent, and manganese, 0.60 to 0.80 per cent.

In my practice I never allow the silicon to go below 2.75 per cent and I prefer to have it as near 3 per cent as practical. The sulphur should be kept as low as possible, but under 0.08 per cent is as low as can be expected on account of the remelt which constitutes 40 per cent of the iron melted; 0.60 per cent is too low for phosphorus which should be nearer 1 per cent to make the iron fluid. Manganese, however should not exceed 0.50 per cent. High silicon irons generally contain more than 1 per cent of phosphorus. You can purchase other pig iron for your mixture containing manganese, 0.50 per cent. Considerable sulphur is absorbed from the coke and great care should be exercised to keep this element low.

Metallic titanium is inflammable only when in a finely-divided state; as solid metal it can be heated red hot and in this property it resembles iron.

Cerium melts at 635 degrees Cent.; its ultimate strength is 12,900 pounds per square inch. Its electrical conductivity is low and its thermal conductivity high.

The metal zirconium is obtained by mixing the oxide with finely-divided metallic calcium and heating the mixture in a vacuum. The product is treated with solvents to remove the gangue, leaving the zirconium in a finely-divided condition which is brought to the massive condition by melting in a Krptol electric furnace. Metallic zirconium is a grayish white metal of 6.44 specific gravity. Its melting point is 1530 degrees Cent.

Foundry to Make Automobile Castings

The Barnes Foundry & Mfg. Co., Detroit, recently organized with $2,000,000 capital, has acquired a site of 30 acres in Ecorse on which a large casting plant will be built for the manufacture of automobile cylinders, crank cases, pistons, etc. The property acquired is between the tracks of the Michigan Central and the Detroit, Toledo & Ironton railroads and is south of the property of the Great Lakes Engineering Works.

The officers of the company follow: Claire L. Barnes, president; George W. Smith, vice president, and Charles E. Pelton, secretary and treasurer. The directors include the foregoing officers with George A. Landon, vice president of the American Radiator Co.; Dwight B. Lee, general manager of the Motor Products Corp.; Edward A. Loveley, vice president of the Stormfeltz-Loveley Co.; Wm. E. Metzger and Frank G. Smith Jr.

Mr. Barnes, president of the company, formerly was vice president of the Detroit Steel Products Co., and for several years was connected with the Willys-Overland Co., Toledo. George W. Smith, vice president, is connected with the Case Threshing Machine Co., Racine, Wis., and Charles E. Pelton, secretary and treasurer, is connected with the Motor Products Corp., Detroit. C. E. McArthur, formerly affiliated with the Western Electric Co., and the International Harvester Co., will be superintendent of the plant.

Steel Castings for Ordnance Construction

Why Certain Specifications Are Unusually Severe—Classes of Gun Carriages and Physical Requirements for Castings Used in Ordnance Equipment

By Major C M Wesson

IN PRESENTING this paper on the subject of steel castings for ordnace construction, I sincerely hope I shall accomplish two purposes: First, to disabuse the minds of some of misunderstandings that I know exist; and second, to be of some assistance to others in the very important matter now with us of producing castings for war material. I purpose to deal principally with plain carbon steel castings, such as can be produced with any commercial installation, using the open-hearth, tropenas converter, bessemer converter or electric furnace, provided proper care is given to details, including finally, a simple heat treatment.

Special heat-treated and alloy-steel castings offer a wide field of endeavor, and our knowledge is rapidly increasing concerning them. The prediction is ventured that eventually they will displace the high-grade intricate forging, just as the plain casting, as we know it today, has in a large measure supplanted the plain forging. We have, however, not time to dwell on them here.

Development of Modern Field Artillery Began in 1900

A brief reference to the situation which resulted in the ordance department of the army undertaking the manufacturer of steel castings, instead of relying on the private manufacturer to produce them, may be of interest. The development of modern field artillery, which today has culminated in the glorious French Seventy-five, our own 3-inch field piece, and the French Schneider 11-inch howitzer, not to mention the engines of destruction used by our adversaries, began about 1900. This departure in type from the artillery carriage, familiar to all in the public squares of our towns and villages, necessitated, as will be explained later, steel castings of thin sections, of the best quality that could be produced. The inquiries proved that it was impossible to get such castings in this country, with the exception of one concern in New York state, which at that time was able to produce a small number of them. This situation resulted in great delays, and hampered our ordnance engineers in their development of the early experimental types of carriages. The large steel companies in Pennsylvania which were furnishing ordnance material, refused to undertake the manufacture of the thin-section castings, and even at a date very much later than this, took the stand that they were not able to make a steel casting of the distance ring for traversing rollers. This was at a time when, due to trouble with the forged steel rings, it was very desirable to procure cast steel ones. It is only fair to say in defense of the steel casting makers, that the inquiries for small steel castings were not for large lots; hence, the inducement to take up a new line of product was comparatively small. This condition aggravated the difficulties, and in the public files there is voluminous correspondence relating to the delays caused by inability to procure small castings. Quoting from a paper dated Feb. 19, 1899, the commanding officer of Watertown arsenal reported that "Shot trucks have been completed and issued. They were all completed except the steel trucks some months ago. Steel casting companies will not take small orders at this time." It was not long after this that a small converter plant was established at Watertown arsenal, due to this situation as regards the small thin casting, which plant has been in continuous operation since then. But why castings of this character? Why should the government ask for an article not demanded by the trade? I dare say the conclusion was reached in various quarters that the specifications were ill-advised, and were the offspring of ignorance and impracticability.

Let us consider for a moment, very briefly, the various classes of gun carriages in use, in the construction of which the large majority of castings under discussion are used.

Gun carriages may be divided into two distinct classes: (1) Carriages for mobile artillery and (2) carriages occupying a permanent or fixed position. It is evident that mobility of gun and mount will necessitate factors in design which are not necessarily considered in a carriage of the second class.

The question is often asked, "Why, for example, is the caliber of a certain gun set at 3 inches or 4.7 inches?" The answer to this is quite simple. The degree of mobility demanded of any piece will depend entirely on its character, being less for heavy siege guns where rapidity of movement is not so essential and greater for field guns which may by necessity have to be moved from place to place with great rapidity, as the progress of an engagement demands.

The power of any tractor or of draft horses must be taken for artillery purposes as less than that which would generally be taken in commercial work. This is due to the fact that on occasions considerable distances might have to be covered at high speeds; and secondly, the roads encountered generally will be inferior.

Problems of Design

Given, for example, the power of a tractive force (six-horse team), at 3900 pounds, the problem was to design a gun and carriage of the greatest possible power, with the requisite mobility to meet the tactical requirements of artillery operating in support of field armies. Considerations such as these led to the adoption, in our service, of the 3-inch field gun and, in the French service, of the 75-millimeter gun. Both of the types referred to are direct fire guns; that is, they are designed for firing at relatively small angles of elevation. If the evolution of the horse had resulted in an animal with the strength of an elephant and the speed of a deer, the modern light field gun, instead of being 3 inches in caliber, would probably be many inches greater, with a corresponding increase in power.

There is also provided in our service a howitzer of equal degree of mobiilty for each gun. The howitzer is a short gun, designed to fire at high angles of elevation, and is utilized for shelling protected positions or, in other words, employs curved fire to accomplish what direct fire would not do.

On the old type carriage, no provision was made for the recoil of the gun on the carriage. Upon firing such a gun, the carriage would jump to the rear

A paper presented at the Boston meeting of the American Foundrymen's Association, Sept. 24-28. The author, Major C. M. Wesson, ordnance department, U. S. A., is officer in general charge of manufacture, Watertown arsenal, Watertown, Mass. Acknowledgment is made by the author to Dr. F. C. Langenburg, metallurgist; R. B. Farquhar, foundry superintendent, and J. M. Sampson, chief melter, for assistance rendered in the preparation of the paper.

many feet, and before the gun could be again fired, the carriage had to be laboriously returned to its original position, and the gun reaimed. Modern carriages permit of relative motion between the gun and carriage, and are fitted with a recoil system for absorbing the energy of the recoil. After the spade is once firmly embedded in the ground, no motion of the carriage to the rear will occur, and in this way the rapidity of fire is greatly increased.

The modern recoil system consists of a hydraulic recoil brake and counter recoil springs or compressed air, these latter being for the purpose of returning the gun to battery after recoil has occurred. The recoil brake consists of a cylinder filled with oil, in which moves a piston. An aperture having a constant or varying orifice is provided between cylinder and piston, one of which is attached to the gun, and the other to the carriage.

The relative motion of the cylinder and piston when the gun recoils, develops a pressure in the recoil cylinder due to the resistance offered by the liquid passing through the orifice between piston and cylinder. The braking action of such a system is very widely varied by the design, and is always adjusted so that the moment of this resistance with respect to the end of the trail is less than the moment of the weight of the gun and carriage with respect to the same point. This condition prevents the wheels from being lifted from the earth during recoil, and thereby disarranging the laying of the piece.

The recoil system outlined above is also applied to heavy seacoast guns and carriages, and it might be of interest to refer briefly to some of their main features. These mounts may be classified in general as either barbette or disappearing carriages. On the former the gun is always exposed above the parapet, while for the latter it is withdrawn behind the parapet by the force of the recoil after each round. As mobility, and in consequence lightness of construction is not a primary consideration in seacoast carriages, the designer has greater latitude in weights of materials employed, and such mounts can readily be constructed which will absorb the energy of recoil of guns of a much higher power than commonly used for mobile artillery. Guns mounted on barbette carriages are sometimes protected by turrets.

These machines form a group which throw projectiles from 12 pounds to two tons, to a distance of from 6000 to 21,000 yards. The tremendous energy of the recoil must be absorbed by the gun carriage which at the same time stores up a sufficient amount to return the gun to its original position on the carriage. This cycle must be accomplished without resultant disarrangement of the carriage; otherwise, the aim will have been disturbed, and rapid fire accurately placed cannot be delivered, and finally, no part of the carriage must be overstrained. The failure of a single part may, and probably will, put the piece out of the action. The painstaking care in the production of the 999 parts may be vitiated by the indifferent quality of the one part.

The force created by the explosion of the charge which sends a projectile on its way, the reaction from which has to be absorbed by the carriage, is sufficient, if uncontrolled, to demolish the gun, the carriage and the personnel which serve them. Further statement to prove that the ordnance engineer must demand material of good quality, appears unnecessary, except it may be added that considerations of mobility in the field pieces require the lest possible weight, which condition reduces the designer's factor of safety to limits far less than is ordinarily permitted in commercial construction.

Physical Requirements of Ordnance Materials

Table I

ORDNANCE STEEL SPECIFICATIONS

Metal	Elastic limit, lbs. per sq. in.	Tensile strength, lbs. per sq. in.	Elongation after rupture, per cent	Contraction of area, per cent
Cast steel, No. 1	25,000	60,000	16.0	24.0
Cast steel, No. 2	35,000	75,000	15.0	20.0
Cast steel, No. 3	45,000	85,000	12.0	18.0
Forged steel, No. 0*	.....	.....	....	....
Forged steel, No. 1	27,000	60,000	28.0	40.0
Forged steel, No. 2	35,000	75,000	20.0	30.0
Forged steel, No. 3	42,000	90,000	16.0	24.0
Forged steel, A	53,000	93,000	18.0	30.0
Forged steel, B†	65,000	95,000	18.0	30.0
Forged steel, C†	75,000	110,000	14.0	30.0
Forged steel, D†	100,000	120,000	14.0	30.0
Nickel steel, Pl	63,000	100,000	18.0	....
Tool steel, A	75,000	125,000	16.0	35.0
Tool steel, B	95,000	140,000	12.0	20.0
Tire steel	50,000	100,000	17.0	30.0
Flange steel‡	40,000	64,000	20.0	45.0
Wrought iron	22,500	50,000	25.0	35.0
Cast iron, No. 1	.....	22,000	....	....
Cast iron, No. 2§	.....	28,000	....	....
Bronze, No. 1	.....	28,000	....	....
Bronze, No. 2	.....	35,000	....	....
Bronze, No. 3	.....	45,000	....	....
Bronze, No. 4	.....	60,000	20.0	....
Extruded bronze	.....	50,000	12.0	....
Instrument bronze	.....	38,000	....	....
Tobin bronze	.....	52,000	30.0	....
Copper	.....	32,000	22.0	....

*No physical test.
†Nickel alloy steels.
‡Physical requirements of commercial flange steel not indicated here.
§Cast iron, No. 2, must not show a tensile strength of more than 39,000 pounds per square inch.

Physical Requirements

Table I, taken from Form 434, "Instructions to Bidders and General Specifications, Etc.," gives the physical properties required of the various materials employed in carriage construction. Particular attention is invited to the three grades of cast steel Nos. 1, 2 and 3.

No. 1 castings are of very mild steel in which the presence of blowholes may be permitted when, in the inspector's judgment, they are not serious enough to affect the value of the casting for the purpose intended. Little trouble is encountered in manufacturing castings of this grade as the ductility requirements, 16 per cent elongation and 24 per cent contraction, are exceedingly reasonable. Cast steel No. 1 is used only on unimportant parts where the allowable section permits the use of a material having a low elastic limit.

Cast steel No. 2 with 35,000 pounds elastic limit, 75,000 pounds tensile strength, 15 per cent elongation and 20 per cent contraction is a better grade than No. 1, and must be free from blowholes. The American Society for Testing Materials on a grade of steel known as "Class B, hard," calls for 36,000 pounds elastic limit, 80,000 pounds tensile strength, 15 per cent elongation and 20 per cent contraction.

The society quoted above expects a higher elastic limit and tensile strength, as will be noted, for a given ductility than is demanded by the United States army. Attention is invited to this fact as there seems to be an opinion in some quarters that the ordnance specifications, U. S. A., are unreasonable.

Cast steel No. 3, 45,000 pounds elastic limit, 85,000 pounds tensile strength, 12 per cent elongation and 18 per cent contraction is a similar grade to No. 2, with the exception that the elastic limit and tensile strength have been increased

and the ductility lowered. Both grades, Nos. 2 and 3, are used for important castings demanding good physical properties.

Proper design will limit the use of No. 3 to parts where the allowable section is limited and the stresses which must be endured demand the use of a material having a high elastic limit.

It is considered advisable to use No. 2 in preference to No. 3 for all members which can be made of such cross section that will allow of the use of a material having an elastic limit of 35,000 pounds.

Cast steel No. 3 is produced by a higher carbon content than is required for No. 2, and the heat treatment is in general different, as will be explained later.

As to composition, the only limitation imposed by the specifications, is that the phosphorus shall not exceed 0.05 per cent and the sulphur 0.07 per cent. Even under present conditions, there is no difficulty in complying with these requirements which are reasonable, less exacting than demanded by A. S. T. M., or the specifications for American railways, and are being met daily at your government arsenal at Watertown, Mass.

I desire to emphasize this point, as some casting makers recently have declined to produce castings for the government, on the grounds of the unreasonableness of the chemical specifications. *The Iron Trade Review* in an editorial on July 12 expressed its opinion on this question in connection with another subject. I may say here that I have been informed that issue has been taken with them on that editorial.

The endeavor thus far brings us to the conclusion of the first part of our topic, which is, to bring out that the specifications for government castings are reasonable, and not more difficult to meet than the requirements on which commercial engineering practice is based, and further that there are sufficient and proper reasons for exacting the reasonable qualities prescribed for them.

(To be concluded)

The Titanium Bronze Co., Inc., is the firm name of the corporation that has been organized to take over the bronze and brass casting department of the Titanium Alloy Mfg. Co., Niagara Falls, N. Y. The constantly increasing demand for the product of this department has compelled this move and the capacity of this foundry is being increased. The sales offices are located at 504 Marine Bank building, Buffalo; the general offices at 165 Broadway, New York, and district sales offices are maintained in the Peoples Gas building, Chicago, and the Oliver building, Pittsburgh.

Shells in Permanent Molds

(Concluded from page 442)

while a casting for the same shell can be made for a little over $2.00. Furthermore, a liberal saving in labor and machine-tool consumption can be effected. When larger projectiles are made, a larger proportionate saving will follow. When more than 1,000,000 rounds per day are made, and this is a low figure to expect, the difference in cost seems incredible. If $6,000,000 or $7,000,000 are spent each working day for shells alone, the incentive for saving a substantial portion of this tremendous outlay becomes a vital necessity especially when the cheaper shells will give as good if not better service than the more costly ones. There is no comparison between the shells when the question of output is considered. Taking dollar for dollar invested in equipment, the output of cast-iron shells is 10 times greater than the output of steel forgings.

The low cost, great output per day and the effectiveness of cast-iron shells have been so completely recognized that two of the warring nations are using them to an enormous extent. France is casting them in sand and Germany, from the best information available, is casting them in permanent molds.

Are Our Foundrymen Awake?

It is doubtful if there is a foundry in the United States that could qualify at once for this work without material changes in procedure. Primarily, it is not a commercial proposition and if this government decides to use cast-iron shells, the work must be undertaken with the foreknowledge that trouble is ahead. The necessity will be paramount of not only putting forth prodigious efforts but also of sinking individuality for the common good. A full and free interchange of ideas and data is indispensable. There is no doubt of the ultimate outcome, but if the experience of those who have been through the mill is utilized, a deal of time, trouble and treasure will be saved.

Personals

W. S. Spieth has been appointed manager of the Davis wheel department of the American Steel Foundries, Chicago, succeeding F. A. Lorenz Jr., resigned.

W. J. Kihn has resigned as foundry superintendent of the Gurney Electric Elevator Co., Honesdale, Pa., to accept a similar position with the Modern Foundry Co., Cincinnati.

Norman L. Warford, mechanical engineer in charge of construction for the Powdered Coal Engineering & Equipment Co., Chicago, sailed from New York recently to take up his new duties as engineer in charge of the coal pulverizing and copper smelting department of the Societe des Mines de Cuivre de Catemou at Catemou, Chile.

J. M. Barringer, formerly superintendent and sales manager of the American Malleables Co., Lancaster, N. Y., is now efficiency engineer for the Timken-Detroit Axle Co., Canton, O.

F. C. Fish has been appointed superintendent of the Marion Machine, Foundry & Supply Co., Marion, Ind. Mr. Fish was formerly superintendent of the foundry operated by the Advance-Rumley Co., La Porte, Ind.

Edgar Allen Custer, of Philadelphia, who has developed a permanent mold for producing castings without the use of sand, to a high state of perfection, has been assigned by the United States government to the munitions inspection department with the rank of major.

W. A. Janssen, who recently resigned as superintendent of the plant of the Bettendorf Co., Bettendorf, Iowa, has been appointed operating manager of the plants of the Canadian Steel Foundries, Ltd., Montreal, located at Longue Pointe and Pointe St. Charles, Quebec, and the steel foundry and rolling mill of this company at Welland, Ont.

J. M. Barringer, formerly superintendent and sales manager of the American Malleables Co., Lancaster, N. Y., now is connected with the Timken-Detroit Axle Co., Canton, O., in the capacity of efficiency engineer.

C. A. Crowe, formerly manager of the Grand Rapids office of the Asbestos Protected Metal Co., Pittsburgh, has been placed in charge of the Detroit office of this company and N. W. Taber, formerly manager of the Detroit office, has been appointed factory manager of the Asbestos Protected Metal Co.

The Detroit Foundrymen's Association held the first meeting of its 1917-18 season Sept. 13. A paper was read by C. D. Gilpin, Aluminum Castings Co., Detroit, on "Foundry Time Study Methods". The attendance was exceptionally large and the discussion of Mr. Gilpin's paper was spirited. The next meeting of the association will be held Oct. 11. L. G. Blunt will read a paper on "Gray Iron Foundry Practice".

Placet alloys essentially are mixtures of nickel and iron with chromium and manganese. The percentage of nickel is as high as possible in order to obtain wire with the minimum oxidizability. The product is used for electric resistance purposes.

Foundrymen Show Interest in Safety Problems

Report of Meeting of Foundry Section at National Safety Congress, New York, Sept. 13—Modern Treatment of Wounds Discussed

AMID the complex activities of the sixth annual Safety Congress, held in New York, Sept. 11-14, the foundry industry was prominently represented. As heretofore, a special session was devoted to the discussion of foundry safety problems. Approximately 250 representatives of American castings plants participated in this meeting which took place Thursday morning, Sept. 13. F. G. Bennett, safety director, Buckeye Steel Castings Co., Columbus, O., chairman of the foundry section, presided. He was assisted by F. W. Shepard, safety inspector, American Cast Iron Pipe Co., Birmingham, Ala., vice chairman, and S. W. Ashe, educational and welfare department, General Electric Co., Pittsfield, Mass., secretary.

Treatment of Burns

Following the formal reports of the officers of the section, W. E. Watters, National Malleable Castings Co., Melrose Park, Ill., presented a paper entitled, "Methods of Training and Obtaining the Co-operation of Foundry Foremen in Safety Work." Mr. Watters pointed out that it is necessary to assume a sympathetic attitude toward the men in the lower ranks in order to secure their co-operation. He recommended that the safety committees take part in the social activities of the men. Throughout his discourse, the necessity for approaching men on their social side was emphasized.

In the discussion of Mr. Watters' paper it was brought out that safety committees, in the activities of which the men take an active part, are more effective than any other device yet developed for securing co-operation in safety work. It also was suggested that trials of a more or less formal nature be held to ferret out the cause of every accident resulting in the loss of more than a day's time. The culpable persons, it was recommended, should be appropriately disciplined.

Unusual interest centered around a paper entitled, "Treatment of Foundry Burns by Paraffin Substances," by Dr. L. F. Mutschman, chief surgeon, American Steel Foundries, Alliance, O. Dr. Mutschman was unable to be present and the outlines of his paper were presented by S. W. Ashe, General Electric Co., Pittsfield, Mass. Mr. Ashe took up not only the use of paraffin substances for dressing burns but also the Carol-Dakin solution for preventing the infection of serious wounds, such as third degree burns. The methods of applying the Carol-Dakin solution and the paraffin dressing were described. It was stated these two remedies are probably the most important surgical discoveries resulting from the war.

In describing the Carol-Dakin solution, Mr. Ashe said it is 20 times as powerful as other antiseptics. Its success depends in a large measure on the skill with which it is applied.

The paraffin treatment of burns is not exactly new, but it has been recently developed to an effective stage as a result of war demands. The paraffin dressing cannot be used where the wound is infected or suppurating. In such cases, the Carol-Dakin solution must be applied first, and the burn thoroughly sterilized. Generally speaking, the paraffin may be applied directly in the case of first and second degree burns.

New Officers
Metallurgical Section

Chairman
EARL B. MORGAN
Norton Co.,
Worcester, Mass.

Vice Chairman
F. H. ELAM
American Steel Foundries,
Chicago

Secretary
DUDLEY R. KENNEDY
Youngstown Sheet & Tube Co.,
Youngstown, O.

The details of the ambrine or paraffin treatment, as described by Mr. Ashe, are as follows:

"Formerly when a person was badly burned over a considerable surface, it was exceedingly difficult, even where skin grafting was resorted to, for the patient to recover. With the absorption of the body from the burns which occurred, kidney trouble resulted many times and the patient died. Also when the dressings were changed, the pain which the patient suffered was very intense, as the bandage coming off usually took with it some of the new skin which was forming. With the ambrine method, much of this trouble has been eliminated and the possibility of recovery has greatly increased.

"Ambrine itself is simply a very fine grade of paraffin containing antiseptic substances. Various substitutes have been developed in this country, due to the difficulty of obtaining an adequate supply of ambrine. Parresine, which is composed of a light grade of paraffin containing 2 per cent of eucalyptus is one of these substances. Whatever material is used is melted in a water jacketed atomizer and raised to the temperature of 150 degrees Fahr. It is then applied to the surface of the burn in the form of a fine spray.

"The wound is first thoroughly cleansed with a wash such as Carol-Dakin solution, then thoroughly dried before the paraffin mixture is applied. This is best accomplished by means of an electrical hair dryer. After the warm glaze coating has been applied to the burned surface, thin sheets of cotton gauze are placed over the surface of the burn and more ambrine or substitute is applied by means of a camel's hair brush. In this way the wound is completely sealed in a semi-adhesive shell. This process keeps out the air from the wound, and eliminates a very large part of the pain which is usually caused by such burns. Light bandages are placed over the ambrine for a period of several days. When the bandages are removed the shell easily peels off without bringing the new tissue with it. The results which have been obtained from this new method of treatment which is now being used by the United States Steel Corp. and the Schenectady and Pittsfield works of the General Electric Co., has resulted in decreasing notably the period of time necessary for complete recovery over the old method.

Introducing Treatment in America

"Dr. Wm. O'Neill Sherman, chief surgeon of the United States Steel Corp., was really the first to introduce the treatment in this country, and it is largely through his efforts that the new method has been taken up. One notable result in the treatment of third degree burns with the ambrine method is that no scars are left.

"The formula for No. 7 paraffin which may be used as a substitute for

ambrine is presented in the ensuing table as follows:

	Per cent
Resorcin	1.00
Eucalyptus oil	2.00
Olive oil	5.00
Paraffin molle	25.00
Paraffin durum	67.00

"Melt the paraffin durum and add paraffin molle and olive oil. Dissolve the resorcin in absolute alcohol (soluble 2 in 1); add the alcohol resorcin and lastly add the eucalyptus oil when the wax has cooled to about 55 degrees Cent.

"A smaller amount of resorcin may be used. The whole of the resorcin does not remain in suspension, and we have used a paraffin containing 0.25 per cent resorcin with good results.

"Difficulty having been experienced in obtaining resorcin in large quantities, beta naphthol, which has the additional advantage of being a cheaper antiseptic, has been substituted for resorcin in more recent preparations. This formula is as follows:

	Per cent
Beta naphthol	0.25
Eucalyptus	2.00
Olive oil	5.00
Paraffin moll	25.00
Paraffin durum	67.75

"The mode of application of paraffin to the ulceration following frost bite is in every respect similar to the application of paraffin in the treatment of burns, and the results have been equally satisfactory."

Discussion of Paraffin Treatment

J. Stanford Brown, supervisor, department of labor safety and welfare, Carpenter Steel Co., Reading, Pa., said his company has been using the paraffin treatment for burns for three years with unusually satisfactory results.

W. L. Chandler, Dodge Mfg. Co., Mishawaka, Ind., asked whether the Carol-Dakin solution bites or stings and also how often ambrine applications are necessary in the case of burns.

His questions were answered by Dr. C. A. Lauffer, medical department, Westinghouse Electric & Mfg. Co., East Pittsburgh. Dr. Lauffer said the Carol-Dakin solution has considerable sting and that it is not comfortable. Also it burns the skin surrounding the wound if it comes in contact with it. Sometimes the skin is protected from this action by proper applications. In using the paraffin treatment of burns, Dr. Lauffer said it is necessary usually to dress the wounds daily. He also said that atomizers used to spray the paraffin or ambrine frequently clog and give trouble. He described a method of soaking gauze strips in melted paraffin or ambrine, laying them on the wound like shingles on a house, in order to avoid the employment of an atomizer. Preparatory treatment of the wound with the Dakin solution is always necessary in the case of third degree burns, he maintained.

F. W. Shepard, American Cast Iron Pipe Co., Birmingham, Ala., asked if it is good practice to allow first-aid men to apply the Carol-Dakin solution or paraffin substances.

Dr. Lauffer replied that first aid men should not be permitted to use these treatments under any circumstances. He explained that the technic is complicated and said success cannot be expected unless the treatments are in charge of skilled practitioners. This advice was approved by other physicians attending the meeting.

In response to a question by David S. Byer, Liberty Mutual Insurance Co., Boston, Dr. Lauffer said the paraffin treatment reduces the time required for a bad burn to heal fully 50 per cent. Also the wound heals practically without scar, the contractures being negligible.

An interesting paper on the relation between labor turnover and safety work was read by F. W. Shepard, safety inspector, American Cast Iron Pipe Co., Birmingham, Ala. Mr. Shepard pointed out that in the past three years the number of employes at the American company's plant has increased 30 per cent. During the same period the number of men employed one year or more increased 176 per cent; the number of men losing less than four day's time in a year increased 327 per cent; the number of men working every day in the year increased 455 per cent; the production increased 5 per cent; and the accidents decreased 47 per cent.

Mr. Shepard ascribes these remarkable results, particularly the reduction in the labor turnover to the welfare and accident prevention work of the company, which has made it an unusually desirable institution to be connected with. The results achieved are all the more remarkable when it is considered that a large proportion of the employes are colored. The American company promotes its own men, runs a medical and dental department, keeps up a workmen's benefit fund, operates a bank and supports a branch of the Y. M. C. A. Discipline is handled largely by a mutuality committee on which representatives of all the men have seats. The company recently has worked out a pension plan for its old employes.

A paper on "Practical Welfare Work in Foundries" was read by S. W. Ashe, General Electric Co., Pittsfield, Mass.

The foundry session concluded with a paper entitled "Mechanical Safeguarding of Electric Traveling Cranes", by J. Claude Smith, safety director, Inland Steel Co., Indiana Harbor, Ind. This paper covers safety devices for cranes in an exhaustive manner.

In reply to a question, Mr. Smith said he had not observed that cranemen's hours of labor have had any effect on crane accidents, although the 12-hour day is the rule. This was disputed by J. C. Feehan, factory inspector, state of Pennsylvania, Pittsburgh, who said there were four fatal crane accidents in the Pittsburgh district in 1916 which in his judgment could be ascribed to excessively long hours of labor. In one investigation, he said, the crane operators in the mill admitted they took naps while on duty.

In order to simplify the work of the Safety Council as a whole it was decided to consolidate the activities of the foundry and iron and steel sections. These sections in the future will be known as the metals and metallurgical division of the National Safety Council. The names of the officers of this division for the ensuing year accompany this report. It is probable that four sessions will be held by the metals and metallurgical division at the seventh annual Safety Congress next year. The place for the next meeting of the congress has not yet been selected. At the present time Cleveland is receiving the most serious consideration.

Influence of Impurities on Tensile Strength

By W. J. Keep

Question:—I have been seeking definite and reliable data on the effect of the ordinary impurities in cast iron on its tensile strength, but have been unable to locate such information.

Answer:—If you know the influence on the transverse strength of the ordinary impurities in cast iron, the same will apply to the tensile strength. If you will refer to the Transactions of the American Society of Mechanical Engineers, Vol. XXV, 1904, pages 884 to 919, you will find a series of tests which will give you all of the information that you desire.

The speed of cooling exerts more influence than slight changes in impurities and, therefore, a casting ½ inch square is much stronger per square inch than one of larger section.

A direct answer to your question is that iron with the closest grain and

the least graphite is the strongest. Such iron, however, is liable to contain blowholes, shrinkage cracks and spots containing dirt. Slight additions of ferromanganese, ferrosilicon or aluminum will remove these without decreasing the strength of the solid parts. A further increase of silicon or aluminum will increase graphite and as soon as brittleness is overcome and the casting is as soft as needed for machining, any further increase will decrease strength by increasing graphite and causing the grains to become coarse and large. A further increase of manganese above 1 per cent hardens the casting, but increases the strength.

Working backwards, we will take a carwheel mixture as an example. An increase of sulphur will increase the chill and cause the grain to become closer, and if blowholes are not formed, the strength will be increased. When phosphorus is about 1 per cent or over, a peculiar grain is produced which will decrease the strength. For the strongest castings, all of these elements should be as low as possible. Phosphorus prolongs the period of fluidity and helps to fill the mold and to make a sharp casting. Silicon softens and acts like phosphorus as described, but increases graphite. Sulphur always is a disadvantage except in chilled castings. Manganese, however, is expected to eliminate to a large degree this annoying and unnecessary element.

Organizing for Welfare Work in Foundries

By S W Ashe

FOR some time many large foundries have carried on welfare work. Foundries that have undertaken such work are still continuing it, indicating that they feel it has been wise. However, it is difficult for the small plant with limited means at its disposal to know just what to do.

Statistics show that from 50 to 60 per cent of accidents are due either directly or indirectly to those employed less than six months. These accidents are due either to the carelessness or inexperience of the new man in either injuring himself or some one else. Thus if means can be developed for holding workers in employment for longer periods or decreasing labor turnover to reasonable proportions, accidents will automatically be reduced 50 per cent. In addition to heavy accident rates we find in plants with a high labor turnover, much restlessness, poor *esprit de corps*, little initiative and low efficiency.

There is no factor which means quite so much to an employe as the factor of stability. Where attempts are made to regulate production, so that employes are not periodically out of work, a better condition is created than in those places where a continual feeling of uncertainty exists. High labor turnover is the cause of more ills than it is ordinarily given credit for.

We can always trace some good in any form of welfare work, depending upon the angle we view it from, but the question naturally arises as to what counts the most. We should place ourselves in the position of the average employe and ask what really counts the most and what things in emergency we could dispense with. It is evident from this viewpoint, with the present high cost of living and with war conditions, that things which bear a direct relation to the employes' salary are the things which count the most. These are the things which necessarily exert the greatest holding influence. Company gardens, bonuses, selling articles, such as coal and insurance at cost, have the greatest weight these times. Where we get employes in the habit of saving their money and purchasing in bulk at the proper season we are not only establishing the fundamentals of thrift but at the same time we are solving many of the problems of labor turnover.

The average workingman has a large amount of free time at his disposal which should bring him in, if properly used, a fair revenue and when fall comes if this man has his cellar full of winter's coal, wood and vegetables and is in good physical condition as a result of his out-of-door activities, his whole viewpoint towards life and his company will change and he will stick to his job.

Establishing a company garden is equivalent to creating a medium whereby the employe can use his spare time to advantage and obtain a revenue which reduces considerably his living expenses. The employe benefits considerably by being in the open air, his spirits are better, his health is better and he is more cheerful and contented.

The accompanying illustration shows

(*Concluded on page* 467)

EMPLOYES GARDEN AT PITTSFIELD WORKS OF GENERAL ELECTRIC CO. WITH EXPERT EXPLAINING POTATO DISEASES

Presented at annual congress, National Safety council, New York, Sept. 11-14. The author, S. W. Ashe, is associated with the General Electric Co., Pittsfield, Mass.

Solving Electric Furnace Power Problems

Co-operation Between Central Station Men and Furnace Operators is Necessary to Secure Best Results—Future of Electric Furnace

By Edwin L Crosby

PROBABLY no instrument for the use of electrical energy for industrial purposes, other than the induction motor, has caused as much interest among both central-station operators and their patrons as the electric furnace, particularly in its application to the steel industry. Arriving as it did to that state of development which allowed its installation as an economically practical piece of apparatus simultaneously with an unprecedented demand for the very materials to the production of which it was most suitably adapted, the electric steel furnace has come in for very exhaustive consideration by the various individuals, manufacturing companies and societies interested in the production or sale of either steel castings, electric steel furnaces, or electrical energy.

Up to the present time approximately 200 steel furnaces of various types having an annual capacity of about 1,200,000 tons of steel have been installed or contracted for on this continent. This steel production involves the use of approximately 750,000,000 kilowatt-hours per year. Thus is the very healthy interest of the aggressive central station man in the problem justified.

Errors Have Been Made

Naturally in the attempt to secure all the new business possible by the use of electric furnaces, many concerns both in the steel castings trade and central station business have made serious errors. Many steelmakers and foundrymen have installed furnaces which for various reasons were utterly unsuitable for their use. Also many central stations have listened to the luring tales of various highly estimable furnace salesmen and permitted, even urged, the connection of furnaces to their lines, the operation of which was fatal to the happiness and peace of mind of the entire production department of the stations concerned. Beautiful visions of regulation equivalent to that of a lighting load, perfect phase balance, etc., have become nightmares of despair to not a few of the power companies of the country. Others have quoted rates for this class of service inconsistent with the characteristics of the load with rather disastrous results to their balance sheets.

To avoid unnecessary repetition of such occurrences it is essential that a closer study of the adaptability and operating characteristics of electric furnaces in general and the more common types of steel furnaces in particular be made by foundrymen contemplating the installation of such apparatus as well as by the central stations from which the foundrymen are likely to purchase power.

Has a Right to Advice

Any foundryman has a right to expect intelligent advice from his local central station on the electrical characteristics, their advantages or disadvantages, of any electrical equipment he may contemplate purchasing.

Central stations certainly stand ready to advise a storekeeper as to the best form of lighting equipment for him to use; they also are prepared to tell the power consumer which type of motor is best fitted for the particular purpose under consideration. An aggressive, wide-awake central station engineer is even able to advise intelligently upon problems involving various types of refrigeration equipment, valve gear, of air compressors, etc., giving due consideration to their effect on the customer's "demand", energy consumption, etc., and the consequent rate he would earn.

By the same token, the central station anticipating electric-furnace business should be prepared to discuss intelligently with the buyer of an electric furnace the electrical and metallurgical characteristics of the various types offered for sale. The power salesman must have a fairly good understanding of the metallurgical practice involved before he is able to give dependable data on the electrical performance of any furnace as these two matters are very closely related. For instance, an electric steel furnace connected to a large power system capable of handling large blocks of energy may be operated with less regard to fluctuating power input than if it were connected to a system of which the furnace constituted a large proportion of the total load.

Take a specific case—melting and refining cold scrap for small steel castings. The only limiting factor in the rate of current input during the melting period seems to be the effect upon the customer's demand. The scrap has an infinite capacity for absorbing heat, the refractories will not be injured, the radiation losses per heat are decreased and the electrical equipment, if properly designed, can stand considerable overload during this period, if it is really desirable to increase the rate of energy input. When refining, however, a much lower rate of heat, hence energy, input may be desired, perhaps only that rate necessary to maintain the temperature already acquired until sufficient time has elapsed for the desired chemical reactions to occur. It would seem, therefore, desirable to operate with a much higher arc voltage during the melting period, decreasing the potential when the bath becomes fluid and refining is begun. It is entirely possible that such a method may result in a lower cost of power per ton. Quite certainly it would result in a lower current consumption per ton, and if carefully controlled, an extra heat per day is easily obtained. Balanced against the increased demand charge per ton of metal are lower overhead charges, lower labor charges, lower radiation and electrical losses and general increased operating efficiency.

Co-operation is Needed

Here is where it is quite necessary for the central station man to assist the furnace user in determining the most economical point for operation. The method of determining demand and greater current fluctuations upon the distribution system are important factors in the determination of this point, and require a fair degree of familiarity with electric-furnace practice as well as with the central-station rate schedule.

In this connection, it is the writer's sincere belief that there is considerable opportunity for standardization of demands by the central stations of the country. It does not seem reasonable that local conditions are sufficiently diverse to account for the extremely variant methods now em-

A paper presented at the annual meeting of the American Foundrymen's Association at Boston, Sept. 24-28. The author, Edwin L. Crosby, is affiliated with the Detroit Edison Co., Detroit.

ployed by companies selling service under relatively similar conditions.

While the cost of power per ton of steel produced is of course important, being one of the greatest tangible items in the cost sheet, the writer has visited several electric-furnace installations where power cost seemed to be the paramount issue, while in reality a lack of superintendence and generally loose organization ran up charges far in excess of any reasonable power cost. As a matter of fact, industry in general is rapidly awakening to the fact that with the present greatly increased cost of labor and material together with a very slight (if any) increased cost for electricity, the power cost of most any article manufactured is not as important as formerly was the case.

Heretofore, the greatest item for consideration among central stations desiring an electric furnace-load has been the power factor. There is no occasion for unrest upon this point at the present time, as very careful investigation of several furnaces of various types has shown that with the possible exception of one type of arc furnace, and the certain exception of the induction furnaces, all steel furnaces on the market today, if properly installed, will operate with a power factor of 0.80 to 0.85 during the early stage of the melting period, later rising to 0.85 to 0.90 and finally to a point as high as 0.95 or better during the refining period.

May Have a Leading Power Factor

Inasmuch as single-phase arc furnaces should never be connected to polyphase systems, except through phase converters, while induction furnaces operate more satisfactorily at frequencies below those in general use, thus requiring frequency changers, either of these types, thus equipped, may be connected to a polyphase system so as to impose unity or even a leading power factor.

Regulation, phase balance and wave distortion have not, on the other hand, received the attention they undoubtedly deserve. Present electrode regulation is at the best very unsatisfactory, it being impossible with any existing equipment to obtain sensitive regulation without considerable hunting of electrodes and disturbance of phase balance. If it is proposed to connect an electric furnace to a network properly designed to satisfactorily operate under existing conditions and with existing load, very careful consideration should be given to this point of regulation, and it may be advisable that carefully selected reactances be placed in the furnace circuit.

Recent oscillographic investigations have shown a very marked distortion of the current wave in all types of arc furnaces. This subject is a very important one as it may affect the accuracy of induction type watt-hour meters. Large wave distortion is also detrimental to the operation of other apparatus connected to the system, for instance, lowering the efficiency of rotary converters.

At first thought it may seem that such subjects are irrelevant before a foundrymen's meeting, but the writer wishes to call attention to the fact that it is necessary for a public utility serving any particular class of business to charge back to that class any expense contingent upon the service; so that if in order to superpose upon existing systems, satisfactorily operating any new form of load, it becomes necessary to increase the investment to an abnormal point, that investment must be reflected in the rate charged for the new class of business.

The writer does not wish to pose as an alarmist, nor does he believe that in the large majority of cases any such fears need be serious deterrents, but when a central station operating a transmission system of considerable length with somewhat limited capacity in generating and distributing equipment connected, attempts to take electric-furnace business, especially at rates based upon existing conditions, it is quite likely to get into serious difficulty which may later cause the station, as well as the furnace user, deep regret.

For the reasons mentioned it is obvious that the representative of a central station anticipating electric furnace business, should thoroughly familiarize himself not only with the operating characteristics of various types of electric furnaces, but also with his customers' requirements, and after careful consideration should offer an unprejudiced opinion upon the relative desirability of the various furnaces obtainable. It may be good judgment to advise against the electric furnace installation entirely. This was the writer's experience upon two occasions recently. Two customers having more or less scrap to sell and experiencing the universal difficulties in steel deliveries contemplated the installation of electric furnaces to supply their demands. After considering the investment, delivery on furnace and electrical equipment, the uncertainty of the market both during and after the war, the customer in each case was unhesitatingly advised not to make the installation. Incidentally, I believe any central station that urges the installation of electric furnaces for steel based upon the present market may later have cause for regret, unless he receives a rate commensurate with the risk.

The central station and the steel manufacturer have to consider from different standpoints the conditions peculiar to the present time, in deciding whether the investment in an electric furnace or the investment in the power plant and transmission necessary to supply that electric furnace should or should not be made. The steel manufacturer may be able to recover his entire investment by the sale of his output at high prices in a war time market which cannot get enough high-grade steel, whereas the central station is required by financial methods, and in some cases by law, to treat all of its investments as permanent, or if not permanent to be amortized over a long period of time, and is further required to have its rates for all classes of service consistent with one another. Therefore, the central station is compelled to consider the future of the steel market, the permanency of the service and the possibility of selling its capacity to some other industry in case the steel furnace should cease to be profitable to the manufacturer after the normal market conditions are restored.

Perhaps the demand for high-grade alloy steel for new uses after the war will keep all the electric furnaces busy. Perhaps the increased cost of labor and fuel will operate against the open-hearth or other less efficient processes sufficiently to allow the electric furnace to compete in ordinary tonnage production. The central station certainly hopes so. But meanwhile any installation should be carefully considered.

Such advice at this time is perhaps superfluous, as it is doubtful whether deliveries on electric furnace equipment are attractive enough to cause any great interest.

Should Compete Successfully

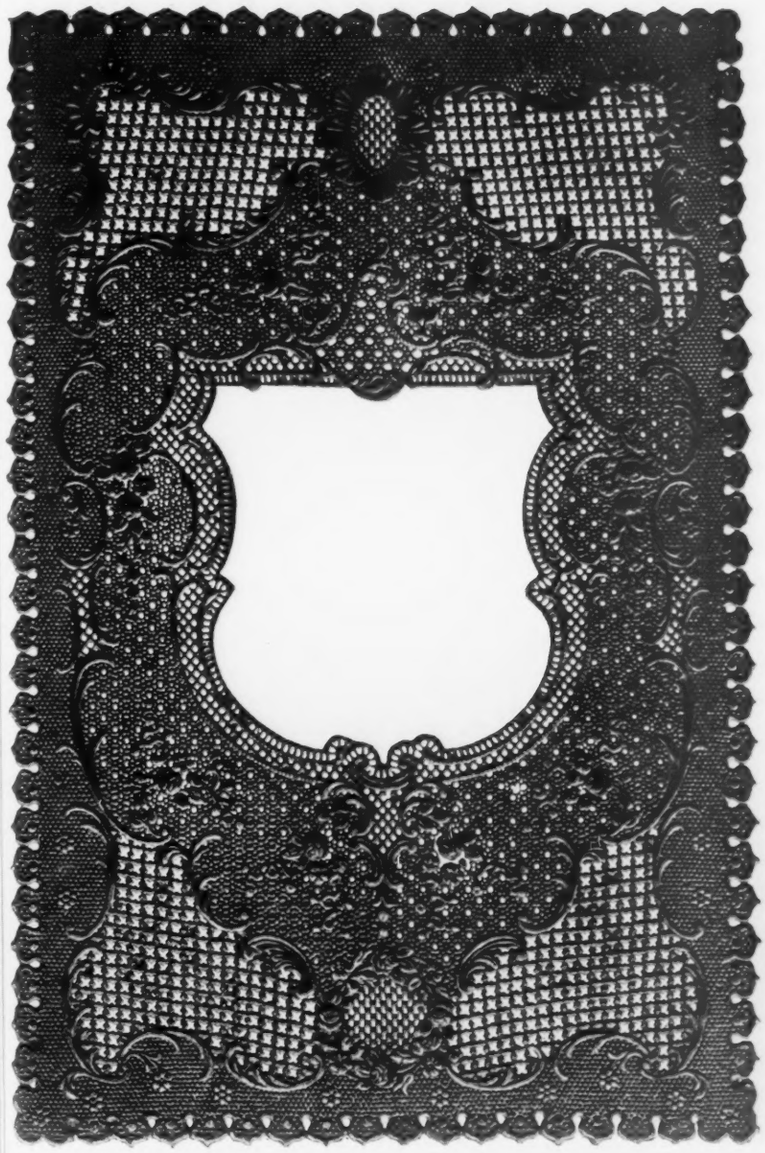
As stated in the report of the electric steel furnace committee to the National Electric Light association this year, that body believes that the electric furnace should supplant or successfully compete with the crucible or converter processes for any purpose. It should, given usual freight differentials, supply local markets with the equivalent of the higher grade open-hearth material, local scrap markets being favorable. However, under normal conditions the committee did not feel that the electric furnace was a competitor in tonnage steel.

In the steel castings trade there appears to be no reason why the electric furnace, when thoroughly developed, should not supplant practically all other methods in foundry use. By

Craftwork in the Foundry

Remarkable Gray Iron Reproductions of Early Artisans' Masterpieces

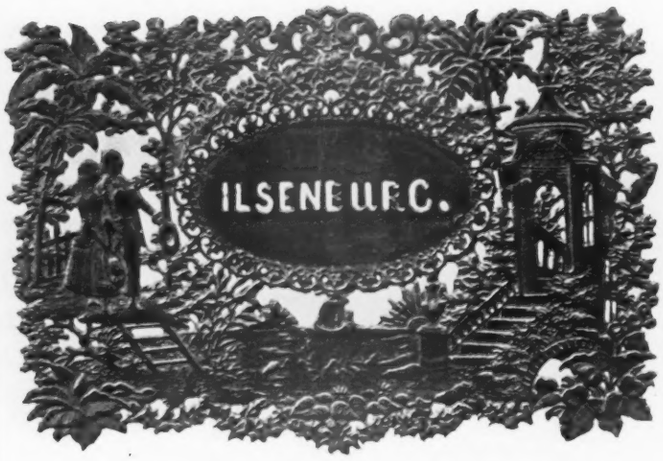
THE period of the renaissance was marked by a revival of craftwork in metals throughout continental Europe and England. In France, Italy and Spain the tendency was toward the use of the rarer metals in filigrees and plaques of artistic and intricate design. The influence of the harsher climatic conditions of the northern countries is reflected in more substantial art pieces in iron and bronze. These consist largely of balustrades, cathedral doors and other productions for architectural purposes. Reproductions in gray iron of some of the fine art pieces in German museums are shown on this and the following page. With his wonderful ability to imitate, the German has reproduced in iron many of the artistic boxes and plaques wrought by the renaissance craftsman in gold and silver. The gray iron castings which are illustrated are a part of a collection owned by John A. Penton, of Cleveland. Additional views of the skillful work of German foundrymen will be published in the November issue of THE FOUNDRY.



A remarkable example of skillful molding and pouring—This casting is so thin that it is as flexible as light cardboard—The uniformity of the border and interior designs show the foundryman's excellent technique

Many handsome gold and silver jewel boxes are exhibited in the German art museums—This is a copy of a plain handchased case

The original of the illustration at the left is about twelve inches long and eight inches wide—All the intricate details of the complex design have been ingeniously reproduced



Cast iron calling card—More beautiful than useful

Finely polished surfaces reveal the high quality of the metal used for the production of these remarkable gray iron castings—The iron runs high in phosphorus and is unusually white in quality—This is shown by the various buffed surfaces of the plaques and boxes—A fine grade of green sand is used in making the molds—The thin cross-section of the two plaques makes them lace-like in appearance and weight

The boxes shown here are from four to six inches high—The plaques on these pages are about twelve inches in diameter

close co-operation between foundrymen and the central station people that development can quickly be carried to completion. We may reasonably hope to realize that long anticipated ideal which I once heard stated at a meeting of this society by a representative of a competitor of the electric furnace, namely: "The electric furnace method is the *ideal* method for making *ideal* steel." The central station is willing to do its part.

A mixture of powdered aluminum, whiting, varnish and alum has been patented and is used for the purpose of filling joints or seams as a substitute for solder in the case of interlocking seams of metal cans.

Manganese Decreases Electrical Conductivity

Question:—We would like to know whether the addition of manganese to steel increases or decreases its electrical conductivity.

Answer:—Manganese steel is not magnetic. Electrical conductivity increases with the purity of the iron. Manganese is one of those elements which, according to the amount contained in the alloy greatly reduces electrical conductivity. Likewise nickel has an appreciable effect on this phenomenon and much in the same way.

Answering this inquiry direct, the degree of the electrical conductivity of steel is largely governed by the amount of manganese the alloy contains. The lower the manganese content the higher the conductivity, assuming that the percentage of other elements in the alloy are the same. However, one might obtain the same degree of conductivity with more nickel and less manganese, although it is unusual for steel containing a high percentage of manganese to contain also a high percentage of nickel.

As to the reason for the characteristics of certain elements and the affinities for others and combination of others, it is beyond the power of even a modern scientist to throw much light. We know that certain elements have certain characteristics and certain affinities for each other, but we know very little about why they act as they do.

Preventing Accidents in Industrial Yards

By F G Bennett

ATTENTION has been directed to this phase of accident prevention, no doubt by severity, rather than by frequency of accidents. There has been a general improvement in all plant yards in the iron and steel industry, where accident prevention work has been definitely established. This has been brought about by the recognized methods employed in accident prevention, engineering and organization. The engineering phase of this work will be slowly noticeable in established plants, but must be recognized in new construction. There are certain features along structural lines that, in our present plants, can be modified, but an extreme hardship will be placed upon certain companies where present construction is so established that changes are almost prohibitive.

Proper Clearance

In considering intrayard railroads, we must recognize a different condition than that of main line railroads where speed is a factor. This one aspect must have a bearing in formulating clearance rules, either from a statutory viewpoint or otherwise. The state commissions throughout this country, which have jurisdiction over railroads, have thoroughly covered the clearance problem, but this seems to be applicable to fast moving trains.

In plant yards the movement of trains is practically limited to switching, placing of cars on loading tracks and other slow movements. In steel plants, there are movements that require speed, but this can be regulated and provisions made to insure safety. The subject of clearances would not be such a problem if new construction was to be considered, but in established plants where buildings have stood for a number of years, it is almost prohibitive to make modifications to which clearance rules can be applied.

At a recent public hearing before the committee which is endeavoring to formulate rules to govern intrayard railroads under the direction of the industrial commission of Ohio, the question was raised as to what a safe clearance should be in plant yards, and a majority favored 6 feet 6 inches from center to track. The state of Ohio public utilities commission has adopted a clearance of 7 feet from center of track.

In plant yards in connection with railroad tracks, there are always conditions where special safety measures such as warning signs and other mechanical devices that will warn employes of close clearances, must be employed. In plants where old installations prevent the application of defined clearance rules, such measures are necessary.

Overhead clearances in plant yards are most commonly applicable to entrances to buildings and this must be carefully studied and considered when formulating a clearance rule. The roller type door is of particular importance in the matter of overhead clearances. If too great a clearance is designated, there is danger of the door not being raised its entire height of travel, due to the fact that it requires more exertion to operate, and in some cases motive power would have to be used. This would be the case, no matter what clearance rule would be adopted, but the present requirement of Ohio in cases of this kind is a clearance of 21 feet. A clearance of less than 21 feet can be adopted and with the use of warning signs or other devices, should be ample in relation to safety. Other conditions in connection with the clearance problems such as double tracks, curves, switches, canopies, awnings, etc., can be satisfactorily handled after the lateral and overhead rules have been definitely arrived at. The speed of trains and locomotives in plant yards should receive attention and in most of our plants this is taken care of through discipline and rules.

Keep Your Yard Clean

A phase of this subject that cannot be lightly passed over is general cleanliness and tidiness throughout plant yards. This applies more directly to railroad tracks and an unceasing campaign to remedy this evil should be inaugurated. A clean-up gang in the larger plants, whose duties are limited exclusively to keeping the plant in a clean and orderly condition will find sufficient work to take up their allotted time. Barriers, constructed of timber of sufficient height to prevent material rolling down should be erected at the base of all piles which are located adjacent to tracks. These barriers, of course, should be placed in compliance with clearance rules.

In connection with railroad tracks there are, of course, quite a few accepted safety devices, such as enclosed frogs, switches, locking devices, derailers and signals that are helpful.

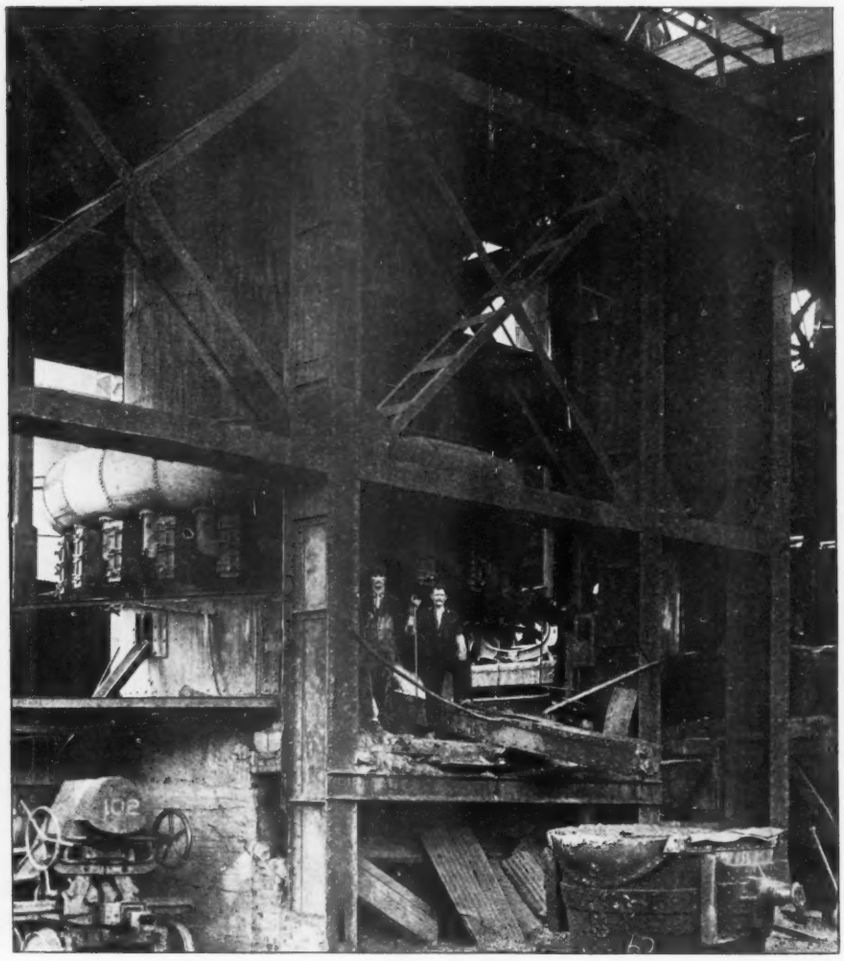
Presented at annual meeting of National Safety council, New York, Sept. 11-14. The author, F. G. Bennett, is director of safety, Buckeye Steel Castings Co., Columbus, O.

Pedestrians in and about plant yards require protection and there are many devices employed at the present time in this respect. Warning signs and baffles at grade crossings near corners of buildings and at doorways furnish protection that is acceptable to safety engineers today. Buildings which are located close to railroad tracks should have the windows on the ground floors closed by screen or strips to prevent employes using them as a means of exit. Designated foot walks about plant yards will help to prevent employes from using other avenues and short cuts. The use of railroad tracks as pedestrial avenues should be prohibited.

Vehicular traffic, both horse and motor, demands attention, as the latter is being more commonly used each day. The usual traffic rules should apply to motor trucks in plant yards as are in use on the public highway. It is possible to exercise more direct supervision over drivers who are in plant yards than those on the public thoroughfares and as there are not many of this class of employes, good results can be attained. It is exceedingly important that proper roadways and cross-overs be provided and maintained in good order.

A great many plants, engaged either directly or indirectly in the production of munitions and supplies for the war, have adopted extraordinary measures in the matter of protection from plotters and others intent upon interfering with this work. The lighting of plant yards by means of projected rays from searchlights has become popular, but all should give this matter close attention. The effects of the glare of these intense rays are well known and care should be exercised to see that railroaders and others are not subjected to the direct effect of these lights. This applies also to street cars and outside railroads that may run close to the boundaries of a plant. If possible, these lights should be placed at a considerable height and better results can be attained by flooding the area in this manner than by locating these lights on fences and other fixtures near the ground.

There is no doubt as to the importance of safety work in yard practices and defined and studied methods should be employed. All must remember that employes of shops and buildings are permitted the freedom of plant yards at times and they practically constitute a third party.



SCRAP MELTING CUPOLA 14 FEET IN DIAMETER IN OPERATION AT MINNEQUA WORKS OF COLORADO FUEL & IRON CO.

Large Scrap Melting Cupola

What is believed to be one of the largest cupolas in the United States is in operation at the Minnequa works of the Colorado Fuel & Iron Co., Pueblo, Colo. It is employed for remelting ladle skulls and other scrap. It is 14 feet in diameter inside of lining and about 28 feet in height above the hearth. It is of the bessemer type and is provided with a bustle-pipe and individual tuyeres instead of a wind box. In this respect it is similar in construction to a blast furnace. In fact, it is equivalent in capacity to many of the small furnaces in operation 20 years ago.

The output is about 300 gross tons per day. The hot metal is transferred in ladle cars directly to the open-hearth furnaces, without being put through a mixer. The cupola, therefore, materially augments the output of the blast furnaces at the Minnequa works, and in times like the present, when tonnage is the chief consideration, it is of immense advantage.

The general arrangement of the charging platform, which is of steel plate construction, is shown clearly in the accompanying illustration. The cupola is open at the top flush with the charging platform. The coke and scrap are charged in large buckets handled by a heavy traveling crane. The charging operation is very simple, the buckets being merely dumped over the top of the furnace. A hole in the roof over the cupola provides for the exit of the gases. The cupola is slagged-off like a regular blast furnace, the slag notch being shown at the left in the illustration.

Economical Radiator Cores

By G. C. Olmstead

The writer has charge of a shop in which radiator cores are made, and in order to reduce the cost of these cores a number of experiments have been made, the results of which may be interesting. The cores used before the experiments were undertaken were plain mixtures of sand, oil and water. These cores, of course, were very strong, but they were also somewhat expensive.

In experimenting with the different mixtures, sample cores 1 inch square and 14 inches long were used. They were supported horizontally between two ⅜-inch rods spaced 12 inches apart. A pail was suspended from the center of the core under test and water was poured into the pail as uniformly as possible until the core

broke. The weight of the pail and the water was then determined and the modulus of rupture computed according to the following formula:

$$S = 3\frac{WL}{2bd^2} \text{ in which}$$

S is the modulus of rupture, W is the breaking load and L, b and d the length, breadth and depth of the core, respectively.

These experiments were not made with scientific exactness, but the results checked fairly closely. They were sufficiently free from error for practical purposes.

The details of the experiments are given in the accompanying table. The sand was clean and of medium grain size. It was pumped from Lake Superior at Duluth.

The experiments showed that many factors affect the strength of the core. They must all be taken into consideration in making comparisons. These factors include the nature and quality of the ingredients, the time of baking, the temperature of baking, the humidity of the oven, the completeness of the mixing, etc.

In radiator work, completed molds occasionally stand for 24 hours before they are poured. In such cases, the cores must not absorb moisture. Also, the sand must not scuff or roll up while striking off, as this will make cores under size. The mixed sand should be of such a nature that it will stand for several hours without caking or drying out appreciably. The cores must vent freely and the mixture should not stick to or gum the core boxes.

Our core room practice prior to making the experiments just described was to dump out a certain number of wheelbarrow loads of sand, add a certain amount of oil and then mix in water until the batch felt right. It was found that this mixture averaged 50 parts of sand to one of oil by volume.

Our experiments led to the following conclusions:

1.—Short baking requires more oil for a given strength.

2.—Thorough mixing adds to the strength.

3.—The practice of mixing according to "feel", described above, produces good cores, although the mixture is very irregular. The modulus of rupture of such cores varies from 137 to 232, whereas from 110 to 125 is sufficient. The additional strength is unnecessary and costly.

4.—The most satisfactory mixture consists of 50 volumes of sand to one of oil, with 7 per cent moisture. The bond should consist of 75 per cent linseed oil and 25 per cent glutrin.

Details of Tests on Radiator Core Mixtures

Test No.	Ratio of mixture	Bond	Modulus of rupture	Per cent moisture (weight)	How mixed	Remarks.
1	50:1	Linseed	157.2	Unknown	Machine	Usual core room practice.
2	50:1	Linseed	84.0	Unknown	Machine	Same batch as No. 1, but tested after bars had been buried in tempered sand 20 hours.
3	Unknown	Glutrin Dextrin Gougeon Soda	176.2	Unknown	Hand	Bars fell to pieces after being buried as above.
4	50:1	Linseed	232.0	Unknown	Machine	Much stronger than necessary.
5	50:1	"Linoil" and Naphtha	166.0	Unknown	Machine	Cores scuffed up in striking off core boxes.
6	50:1	Linseed	178.0	Unknown	Machine	Good firm core.
7	50:1	Linseed	184.0	4	Hand	Good firm core.
8	50:1	Linseed	247.0	4	Hand	Good firm core.
9	50:1	Linseed	179.0	8	Hand	Good firm core.
10	50:1	Linseed	189.5	Unknown	Machine	Also mixed 5 minutes in addition by hand.
11	50:1	Linseed	159.5	Unknown	Machine	Same as No. 10 without additional mixing.
12	50:1	Linseed 75 per cent Glutrin 25 per cent	150.7	4	Hand	Not thoroughly mixed. Seemed rather stiff and dry mixture.
13	50:1	Same as No. 12	219.0	7	Hand	Excellent core, stood moisture well.
14	50:1	"Parsons"	153.0	7	Hand	Sand rubbed off baked core. Stood moisture well.

In the course of our experiments it was found necessary to determine the weight of sand corresponding to various percentages of moisture. For this purpose the accompanying diagram was plotted. This diagram is also useful in determining how many pounds of water must be added to the bin sand to bring it up to the desired percentage of moisture. The quantities are arrived at as follows:

Let A = cubic feet of sand to be used.
m = per cent of moisture in the sand, determined by sampling.
m′ = the per cent of moisture desired in the sand.
w = weight of sand per cubic foot at m per cent of moisture. (Determined from curve.)
w′ = weight of sand per cubic foot at m′ per cent of moisture. (Determined from curve.)

Then,
Awm = pounds of water in the pile of sand and
Aw′m′ = pounds of water desired in the pile of sand.
Now Aw′m′ — Awm or A(w′m′ — wm) = the pounds of water to be added.

Constant factors may be substituted for any given existing conditions.

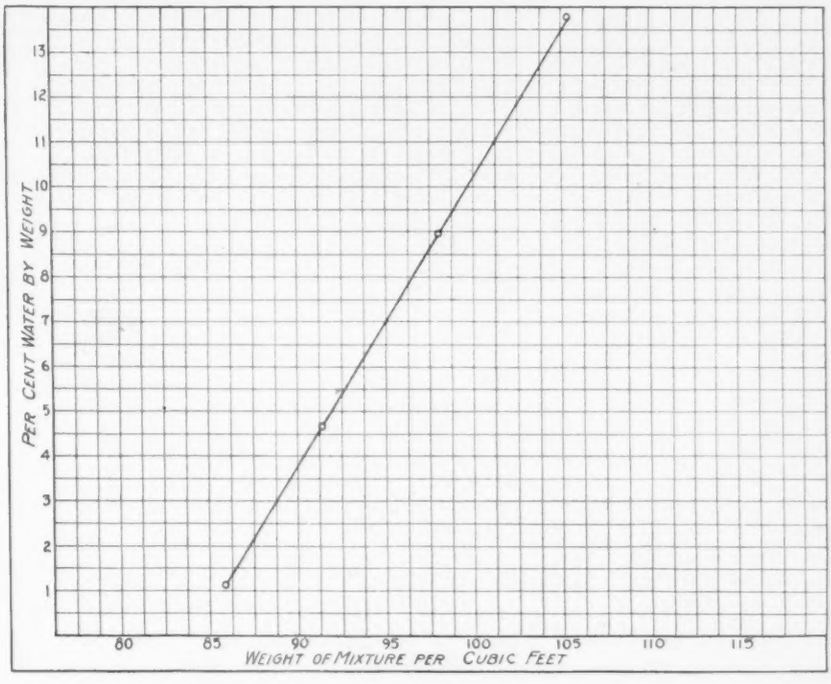


DIAGRAM SHOWING THE WEIGHT OF SAND PER CUBIC FOOT WITH VARYING PERCENTAGES OF MOISTURE

The Values Are for Rammed Sand. For Sand as Shoveled, Add 84 Per Cent of the Weights Indicated by the Diagram

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade

Published by

The Penton Publishing Co.

Penton Building, CLEVELAND

BRANCH OFFICES

BIRMINGHAM, ENG.....Prince's Chambers
CHICAGO.....1521 Lytton Bldg.
CINCINNATI.....205 Lincoln Inn Court
NEW YORK.....508 West Street Bldg.
PHILADELPHIA.....1316 Land Title Bldg.
PITTSBURGH.....2148-49 Oliver Bldg.
WASHINGTON, D. C.....708 Metropolitan Bank Bldg.

SUBSCRIPTION

United States and Mexico.....$1.00 a year
Canada.....$1.50 a year
Great Britain and other Foreign Countries Eight Shillings
Single Copies.....15 cents

Copies published three months or more previous to date of current issue, 25 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 10th of the month preceding date of publication.

ENTERED AT THE POST OFFICE AT CLEVELAND AS SECOND CLASS MATTER

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Contents

	PAGE
Report of Foundrymen's Convention	411
Report of Meetings of Institute of Metals	423
Boston Foundry Exhibit a Big Success	427
The Effects of Seasoning on Gray Iron Castings	435
Making Cast Iron Shells in Permanent Molds	439
Craftwork in the Foundry	443
Calculating Tensile From Transverse Strength	445
Large Foundry to Produce Truck Wheels	445
Tentative Specifications For Brass Castings	446
Problems of the Brass Founder	447
A Non-Shrinkable Pattern Alloy	447
A Core Sand Mixture for Globe Valves	447
Avoiding Cutting of Cores	447
Cause of Flaking	447
Rough and Dirty Yellow Brass Castings	448
Minute Cavities in Brass Castings	448
Cleaning Brass Castings With Acid	448
Can Government Metal Be Forged?	448
Removing Aluminum From Brass	448
Producing Machinable Malleable Iron Castings	449
Ladle Sleeves and Stoppers	451
Mixture For Stove Castings	452
Steel Castings for Ordnance Construction	453
Personals	455
Foundrymen Show Interest in Safety Problems	456
Influence of Impurities on Tensile Strength	457
Organizing for Welfare Work in Foundries	458
Solving Electric Furnace Power Problems	459
Preventing Accidents in Industrial Yards	461
Large Scrap Melting Cupola	462
Economical Radiator Cores	462
Contents	464
Capitalize Your Convention Trip	464
Trade Outlook	464
What the Foundries Are Doing	467
New Trade Publications	468

Capitalize Your Convention Trip

NOW that the 1917 convention is an event of the past, each of the three thousand foundrymen who visited Boston last week has undoubtedly returned to the daily routine more than ever determined to operate his plant in accordance with the principles which make for higher efficiency. Moreover, those who listened to the remarkable papers which were presented during the week of Sept. 24 were certainly charged with a feeling of obligation to the government to do everything in their power to increase the output of the foundry industry. It is doubtful if ever a convention of manufacturers offered more in the way of technical information, shop experience and solution of management problems than the meeting recently concluded in Boston.

On account of the tremendous work involved in arranging for such a convention and because of the difficulty in assembling thousands of foundrymen at a time when the demands of business are most pressing, such events are necessarily confined to one each year. Therefore, the foundryman who would profit most from the activities of the American Foundrymen's association and the American Institute of Metals must make use of every item of information obtained from the annual meeting. The progressive foundryman will do well to study the papers devoted to the phase of the foundry or industry in which he is interested. He will also find ample opportunity to benefit from suggestions received at the foundry and machine shop exhibition. If each foundryman sets out to capitalize his convention experience, the influence of the allied associations will be strengthened and the foundry industry will be greatly benefited.

Trade Outlook

PRICES for pig iron, scrap and other materials used in the foundry industry, which showed an upward tendency during the first three quarters of 1917, assumed indefinite values during the past month. Basic pig iron was the first to show a decline and sales of this iron at from $4 to $6 under the previous high prices were noted during September. All grades of foundry iron have exhibited a tendency toward lower prices. An improved car situation has had a good effect on the delivery of coke, although the Connellsville product still is quoted at comparatively high prices. Sales of pig iron during the past month have been confined to lots of 200 tons and less. No. 2 foundry iron is quoted in the leading centers as follows: Pittsburgh, $53.95; Chicago, $55; Cleveland, $54 to $55; Buffalo, $53 to $54; Philadelphia, $50.50 to $53.50; and Birmingham, $47 to $50. Bessemer is held at $51, valley, and basic is quoted at $42 to $46, valley. Malleable iron is quoted at $55, Chicago, and Lake Superior charcoal iron is selling at from $59 to $62.

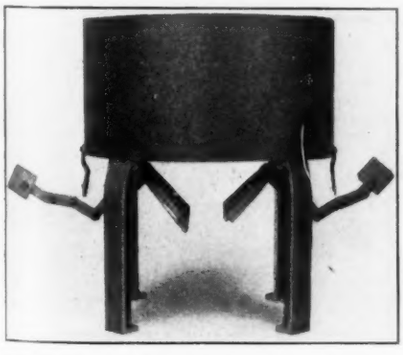
Counter-Balanced Cupola Doors

The accompanying illustration showing counter-balanced cupola bottom doors is almost self-explanatory. The weights and their connecting links are so arranged that they may be adjusted to hold the doors in equilibrium at an angle of approximately 45 degrees. When so adjusted, the doors may easily be closed by one laborer. The arrangement of the counterweights is such that it is unnecessary for the laborer to work underneath the cupola while the doors are being closed. After they have been shut by pushing on the counterweights, however, the man may put the props in place without danger.

When the props are knocked from under the doors preparatory to emptying the cupola, the weights prevent the doors from swinging back and being damaged by knocking against the cupola supports. Also since the doors remain partially closed, the splashing of molten slag is considerably reduced. The doors may be fastened wide open by means of the latches shown in the illustration. This new device is being manufactured by the Federal Foundry Supply Co., Cleveland.

A Complete Sand-Blasting Room

An unusually complete sand-blast installation consisting of a double sand-blast room, sand-blast machine, sand elevating pipe, sand-separator, steel-case cloth type dust arrester and exhaust fan with direct motor drive, built by the Illinois Mfg. & Supply Co., Quincy, Ill., is shown in the accompanying illustration. The operator



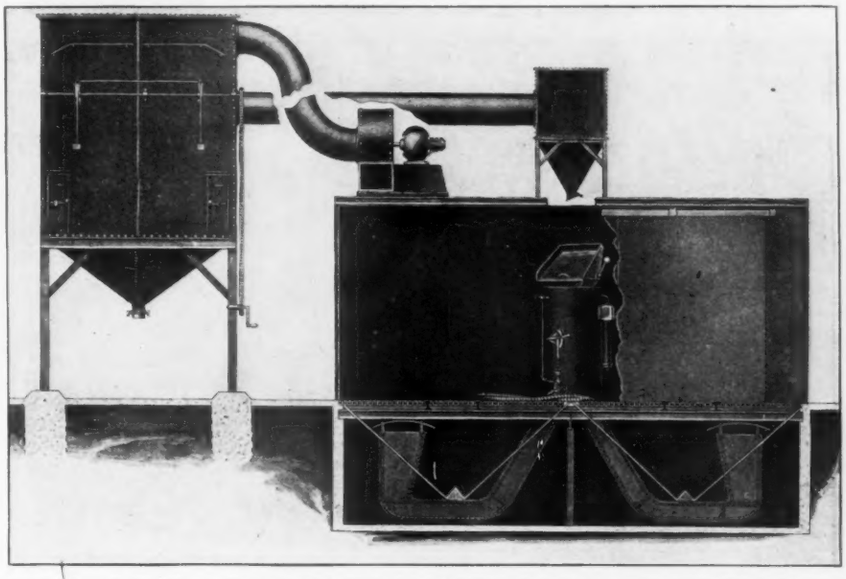
COUNTERBALANCED CUPOLA DOORS SAVE LABOR AND TIME

works in one of the two rooms with the door closed while his helper fills the open room with the castings to be cleaned. In this way this double sand-blast room doubles the output of cleaned castings, over a single room, since the operator never is compelled to stop sand-blasting while removing castings from the room and charging others to be cleaned. When he has finished sand-blasting the castings in one room he enters the other room which has been filled with castings by his helper and proceeds to clean these. A sliding door separates the two rooms. In this illustration the partition between the rooms is not shown.

While cleaning castings, the sand, after having served its purpose, falls through a floor grating and through the heavy iron screen directly underneath the floor which prevents nails, wire, fins, etc., from falling onto the intake pipe. As a further precaution against blocking the end elevating pipe, a revolvable cinder screen is placed directly over the intake pipe thereby insuring a free, continuous flow of sand while operating. When the sand enters the intake pipe it is carried by suction into the sand separator where the sharp cutting sand is separated from the dust in three compartments, thereby dividing the sand into coarse, medium and fine.

Air enters the sand-blast room through perforated plates which form its top, the air traveling downwards approximately 40 to 50 feet per minute, thereby drawing the dust away from the operator's head. This system is so regulated that the air is changed in the room from five to seven times per minute. The air suction is created by the exhaust fan which exhausts the air from the dust arrester, thereby filtering all fine dust from the air and it is discharged by the fan into the building free from dust.

The casing of the dust arrester is filled with a series of cloth screens, suspended at the top in an angle frame attached to the side of the casting. The cloth screens are tapered, being wide at the top and narrow at the bottom. When the rapping mechanism is employed, the hammers strike the rapping bars, one of which is attached to either side of each screen, and since these are tapered and suspended at the top satisfactory vibration of the screens is provided, the dust falling when they are jarred and, therefore, the pores of the cloth are effectively kept open and the fine dust does not cake on the face of the screens. This particular construction is essential to prevent retarding the air suction. Entrance doors are provided on either side of the dust arrester casing.



DOUBLE SAND-BLAST ROOM AND COMPLETE SAND-BLAST CLEANING EQUIPMENT, BUILT BY THE ILLINOIS MFG. & SUPPLY CO.

New Form of Safety Glass

A new form of safety glass has recently been developed by a New York firm. The lens, in the case of a goggle, consists of two layers of optical glass, which may be plain or curved, with a layer of celluloid between. The whole, it is stated, is welded into a solid mass. This combination is said to possess the strength and safety features of celluloid, combined with the advantages of glass. The glass is manufactured by Strauss & Buegeleisen, 37 Warren street, New York.

The Evase stack for creating draft in furnaces is finding increasing application in foreign countries. The process consists in blowing air into a chimney which is contracted to a vase-like shape at the point at which the air is liberated. Its principle of operation is that of an injector, and the fan draws its air from the lower part of the chimney

and discharges it at the contracted point higher up. It eliminates the necessity for building high chimneys, and when applied to brass melting chimneys gives all the advantages of natural draft combined with speed of melting.

Employs Auxiliary Electrode

An auxiliary electrode, in addition to the one, two or three main vertical electrodes, the number dependent upon whether the furnace is to operate on single, 2 or 3-phase power, is a distinctive feature of the newly designed electric furnaces made by the Booth-Hall Co., Chicago. The auxiliary electrode is inserted vertically through the roof except in the small furnaces, where it is projected diagonally through the door. The furnaces also are provided with wrought iron grids which are embedded in the hearth, with a refractory facing.

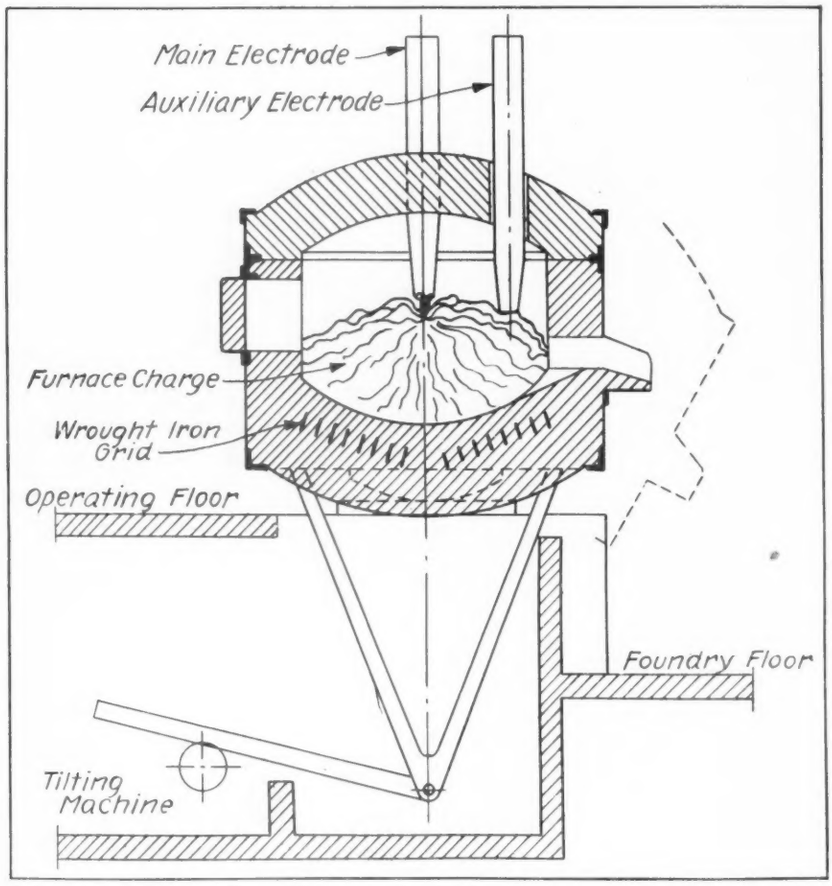


DIAGRAM SHOWING AUXILIARY ELECTRODE RESTING ON SCRAP AND ARCS DRAWN WITH MAIN ELECTRODES

In starting a heat with a cold charge, for example, in a 2-phase furnace, a pawl on the auxiliary electrode holder is released, permitting the secondary electrode to rest upon the charge of scrap. Arcs are then drawn with the two main electrodes and the metal begins to melt under the heat of the arcs. The auxiliary electrode acts as a common neutral, no arc being drawn and consequently no metal is melted under the auxiliary. When a molten bath has accumulated upon the hearth in sufficient volume to make the hearth conductive of current, ammeters indicate the flow of current through the grids and the auxiliary is withdrawn from the furnace and its port is closed. The furnace continues to operate with the current entering through the main vertical electrodes, being carried through the bath and the hearth to grids, passing out through the grids. The transformer connections are so arranged that each phase has a separate circuit.

Use of Auxiliary Electrodes

It is pointed out by the makers that the use of the auxiliary electrode assures a contact with the charge when the heat is being started and that there is no bottom contact touching the bath that may be covered with slag. This system of electrodes also precludes the possibility of arcs in series above the bath. Water-cooled contacts are eliminated in this furnace.

The accompanying illustration shows a general diagram of the furnace with the auxiliary resting upon the scrap. It is to be noted that by having two main electrodes and an auxiliary acting as a common neutral, it is possible to sinter in the hearth, layer by layer, thus producing a monolithic mass providing a durable bottom lining. The furnace is tilted by an arrangement of rockers, steel struts and reduction gears. The rockers are so designed that falling material does not drop on the guides to interfere with the tilt. The furnace may be rocked backward as well as forward so that it is possible to bring the slag line flush with the door, from which the slag is tapped. The tilting mechanism is placed below the floor, where it is covered and protected. Handwheels are provided for the operation of the electrodes in the event of an accident befalling the regulating device.

The Booth-Hall furnaces are built in sizes ranging from one-quarter to 10 tons for 1, 2 or 3-phase power. Smaller sizes generally are confined to single-phase operation, while the 8 and 10-ton sizes are built only for 3-phase power. Two-phase furnaces are used with Scott-connected transformers to balance evenly the loads on the 3-phase supply lines.

Trade Notes

The Pangborn Corp., Hagerstown, Md., has purchased the sand blast department of the Curtis Pneumatic Machinery Co., St. Louis. A complete line of machines will be carried in stock including repairs parts.

Foundrymen of Indianapolis have organized an association to promote their general welfare. The directors of the organization are: Arthur R. Baxter, William H. Holmes, Harry D. Kamp Jr., F. S. Robinson and H. L. Waterbury.

During the past few weeks the Abell-Howe Co., Chicago, sold more than 250 detachable tongue trucks, the orders largely covering complete plant equipment and included contracts from the following concerns: Saginaw Malleable Iron Co., Saginaw, Mich.; Chicago Malleable Iron Co., Chicago; American Radiator Co., Buffalo, and the Rockford Malleable Iron Co., Rockford, Ill.

The American and Foreign Sales Corporation has been organized at Washington, D. C., for the purpose of rendering service for large manufacturers who want personal representation before the government and in this way a similar service also will be rendered to the various branches of the United States government. The officers of this company follow: John L. Newbold, president; Ross P. Andrews, vice president; E. E. Thomp-

son, secretary and treasurer, and Louis C. Witkowski, sales manager.

Welfare Work in Foundries

(*Concluded from page* 458)

a part of the gardens at the Pittsfield works of the General Electric Co. Three hundred gardens were assigned, each 50 x 100 feet. Each gardener signed an agreement stating that he would take proper care of his garden. It was necessary to build 800 feet of temporary fence and run 1000 feet of water pipe line into the property. A "raising bee" was therefore held one Saturday afternoon, the company supplying old lumber and pipe. It took just 40 minutes to complete the work. Care has been taken to check these 300 plots and with the exception of one employe who was dropped, every one has remained with the company and taken good care of his plot.

Coal the past winter was difficult to secure and the price was high. Some companies have tried the experiment of co-operating with their employes in selling coal at cost. At the Pittsfield works, a coal club was formed and 2000 tons were sold at cost. In securing the coal about one-half of the coal was purchased at a low figure and the other half was secured at a somewhat higher figure as it was purchased on a rising market. Nevertheless, the employes supported the proposition exceedingly well. Many of the other forms of work are desirable and the men are generally interested in them, but they exert a holding influence to a lesser degree than the grouping discussed.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Geronimo Motor Co., Enid, Okla., contemplates the erection of a malleable foundry using gas fuel.

The West Bend Aluminum Co., West Bend, Wis., will build a plant and warehouse, respectively 70 x 140 feet and 50 x 60 feet.

Plans have been prepared for a 50 x 100-foot foundry to be erected for the Enterprise Brass Works, Muskegon, Mich.

The Jaeschke Bros. Foundry Co., Milwaukee, has awarded a contract for a concrete sand storage building, 65 x 28 feet.

A foundry addition is being erected by the West Michigan Steel Foundry Co., Muskegon, Mich.

The Bramcote Foundry & Machine Co., Pottstown, Pa., is building a machine shop, 120 x 148 feet and a core room, 24 x 40 feet.

The Trenton Malleable Iron Co., Trenton, N. J., will build a carpenter and pattern shop, two stories, 30 x 128 feet.

The Gray Iron Castings Co., 247 Habaugh street, Detroit, will erect a $10,000 plant, 30 x 48 feet.

The Waterloo Engineering Co., Waterloo, Ia., contemplates the erection of a 150 x 600-foot foundry at a cost of $200,000.

The Aluminum Castings Co., 1576 Joseph Campau avenue, Detroit, is erecting a one-story addition to its machine shop.

A one-story foundry will be built by the Bayonne Steel Casting Co., Bayonne, N. J., at a cost of $10,000.

H. T. Hornsby, Springfield, Mo., has acquired a three-acre site in Baxter Springs, Kans., and will erect a $60,000 foundry.

De Mattia Bros., Inc., Garfield, N. J., will erect a one-story foundry, 70 x 80 feet, at a cost of $9000.

The Fulton Foundry & Mfg. Co., Cleveland, has acquired the Fulton Foundry Co. No changes were made in the management.

The Peru Foundry Co., Peru, Ind., has been incorporated with $60,000 capital by M. F. Gartland, J. H. Schaumleffel and Harry J. Schaumleffel.

The Valley City Machinery Co., Grand Rapids, Mich., has purchased the plant of the Sintz Engine Co., which it will remodel into a foundry.

The Compton & Knowles Loom Works, Worcester, Mass., has awarded the contract for the erection of a two-story, 126 x 277-foot addition to its foundry to cost $15,000.

The Hesse-Martin Iron Works, 434 Belmont street, Portland, Oreg., is erecting a foundry and machine shop at a cost of $100,000,

The Hedges Boiler Works, Mobile, Ala., will build a machine shop, 48 x 40 feet; a foundry, 30 x 60 feet, and a blacksmith shop, 60 x 60 feet.

The Aurora Foundry Co., Seattle, Wash., is building a plant at Occidental avenue and Horton street for the production of iron and steel castings.

The Westinghouse Electric & Mfg. Co., East Pittsburgh, will erect a $40,000 foundry, 165 x 241 feet and a $12,000 machine shop at its Cleveland plant.

A permit has been obtained by the Grabler Mfg. Co., Cleveland, to build a 1-story, 66 x 104-foot foundry at a cost of approximately $25,000.

Contracts have been awarded for the erection of a one-story, 35 x 45-foot foundry and cleaning shed addition to the plant of the Riverside Steel Casting Co., Newark, N. J.

An addition is being erected to the plant of the Lakey Foundry & Machine Co., Muskegon, Mich. This extension will triple the capacity of the plant.

Contract has been let for the erection of a brick, 1-story, 50 x 57-foot foundry for the Coppus Engineering & Equipment Co., Worcester, Mass.

Plans have been completed for the erection of a 65 x 132-foot addition to the plant of the Fulton Brass Foundry Co., South Bend, Ind.

The International Castings Co., Rome, Ga., has been incorporated to engage in the manufacture of stoves, ranges, etc. The company is capitalized at $10,000 by W. A. Smith, E. W. Kreider and others.

The Palmer Foundry & Machine Co., Palmer, Mass., has been incorporated with $15,000 capital, by Michael A. Henebery, William A. Scollen and William C. Mellish, all of Worcester, Mass.

The new plant of the American Machine & Mfg. Co., Atlanta, Ga., will be placed in operation early in September. It is equipped with an acid open-hearth furnace and will have a capacity of 10 tons of castings daily.

Contract has been awarded by the National Malleable Castings Co., Cleveland, for a one-story, 61 x 150-foot pattern shop to be erected next to the large foundry now being built at Quincy avenue S. E. and Woodhill road.

The Williams Foundry & Machine Co., Akron, O., has increased its capital stock and is being reorganized. A three-story, 50 x 275-foot addition will be erected and considerable new equipment installed.

The Bowen Anchor Co., Morton, Pa., is building a 90 x 250-foot foundry which it expects to have in operation about Dec. 1. The equipment includes a 20-ton acid open-hearth furnace.

Hendley & Whittemore, Beloit, Wis., have awarded a contract for the erection of a brick and steel addition, 60 x 125 feet. The company operates a foundry and machine shop.

The T. L. Smith Co., Milwaukee, manufacturer of cement mixing machinery, has purchased the plant of the Wisconsin Foundry Co. of the same city and will continue to operate it as a department of its business.

The Beatty Mfg. Co., recently incorporated with $250,000 capital, has purchased four acres at Hammond, Ind., and will build a steel foundry and shop for the manufacture of heavy machinery at a cost of $50,000.

The Eagan-Rogers Steel & Iron Co., Crum Lynne, Pa., is building additions which will practically double the capacity of its plant. The company has a large order for small castings for the United States government.

The Runyon Corp., New York, has been organized with a capital stock of $25,000 to engage in the operation of a foundry and machine shop. A. W. Britton, S. B. Howard and G. V. Reilly, 65 Cedar street, are the incorporators.

A contract has been let by the Millbury Steel Foundry Co., Millbury, Mass., for a one-story, 50 x 64-foot addition to its foundry and a one-story, 30 x 120-foot pattern storage and office building. The company is installing a heroult electric steel furnace.

The American Mfg. Co., Meriden, Conn., has been capitalized at $50,000 to engage in the manufacture of castings and other metal goods. F. E. Demers, David J. Murphy, O. S. Montambault, all of Waterbury, Conn., are the incorporators.

The Fruit Machinery Co., Belleville, Ont., has been incorporated to conduct a foundry and machine shop business with $40,000 capital stock. The incorporators are Robert J.

Graham, Frank B. Foley, George K. Graham and Jamieson Bone.

A steel and concrete, two-story factory building, 60 x 94 feet, is being erected for the Cope Pattern Works at Wight & McDougall avenue, Detroit. The company expects to remove from its present shop to the new plant about Oct. 15.

A foundry, 75 x 100 feet, will be built at Fulton and Curtis streets, Chicago, for H. G. Lang, 162 North May street, that city. The cost will approximate $15,000. The architect is R. T. Newberry, 208 South La Salle street, Chicago.

The Durbin Automatic Train Pipe Connector Co., 306 Pontiac building, St. Louis, will build a malleable foundry of 20 tons daily capacity. The company manufactures flexible pipe joints and conducts a jobbing business.

The Twentieth Century Brass Works has purchased for $25,000, the assets of the M. H. Foundry & Mfg. Co., Belleville, Ill., consisting of patents, patterns and the entire plant and equipment. The new company will continue the manufacture of plumbing specialties and brass castings in addition to conducting a general machine shop business. William Arlhoff is president; Walter J. Ruediger, vice president and E. E. Wangelin, secretary, treasurer and general manager.

The Wehr Steel Co., Milwaukee, has awarded contracts for the erection of additions to its plant, which include two 80-foot bays costing $20,000 without equipment. When these extensions are completed the capacity will be increased from 300 to 400 tons of converter steel per month.

The firm name of the Framingham Machine Works, Framingham, Mass., has been changed to the Framingham Foundries to define more clearly the line of work in which the company is engaged. The plant recently has been re-equipped with machinery and appliances for the production of gray iron castings and the galvanizing of metal goods.

The Oshkosh Foundry Co., Oshkosh, Wis., has been incorporated with $10,000 capital to engage in the manufacture of gray iron castings. The plant is built and the equipment has been purchased. H. M. Steuck is president; F. T. Turner, vice president and J. W. Radl, secretary and treasurer.

NEW TRADE PUBLICATIONS

PNEUMATIC EQUIPMENT.—The Ingersoll-Rand Co., New York, recently has issued a 20-page catalog devoted to motor hoists and stationary motors; a 4-page bulletin describing a coal pick and core breaker; a 16-page booklet devoted to pneumatic chipping, calking and scaling hammers and an 8-page bulletin describing air receivers, pressure tanks and moisture traps. All of these publications are well illustrated and include tables of sizes and capacities.

ENCLOSED LEVER SWITCHES.—"Safety first" combined lever switches and fuses are illustrated and described in a bulletin recently issued by the General Electric Co., Schenectady, N. Y. The important features of these switches follow: The current carrying parts are completely enclosed and are inaccessible while alive; the switches can be locked in the "off" position and the fuse chamber can be locked to prevent access by unauthorized persons without interfering with the operation of the switch.

SOLVAY ALKALI.—In a 56-page catalog issued by the Solvay Process Co., Syracuse, N. Y., the various forms and uses of alkali are described and notes on alkalimentry are furnished. Chemical and commercial tables are presented and conveniently arranged for the use of the consumer. The products manufactured include soda ash, caustic soda, bicarbonate of soda, and allied products. The soda process is outlined and the uses of the various products are discussed in detail. A large number of views of the plants of the Solvay Process Co. are included.

SPEED REGULATING PANELS. — Designed for use with motor-operated feed water pumps for boilers, gas blowers, mechanical stokers, blowers, etc., pressure-controlled speed regulating panels with automatic pressure regulator, as described in a bulletin issued by the General Electric Co., Schenectady, N. Y., provide a convenient means of controlling the speed of a motor where changes in air or liquid pressure automatically vary the speed. If the pressure runs above or drops below that for which the regulator is adjusted, the motor is automatically retarded or speeded up until the pressure is again constant.

GRINDING AND POLISHING MACHINERY.—A loose-leaf catalog, devoted to the extensive line of grinding and polishing machinery manufactured by the Webster & Parks Tool Co., Springfield, O., recently has been issued. Machines of the ball-bearing and plain-bearing types are built including floor grinders, bench grinders, grinding and polishing machines, wet tool grinders, ring-wheel end grinders, special plate edge grinders, electrically driven grinders, etc. In addition, numerous safety devices are illustrated including wheel guards and similar equipment. An extensive line of polishing and buffing lathes also is shown. The catalog is unusually well-illustrated and contains the necessary specifications covering the sizes and capacities of all of these machines.

MONORAIL HOISTS.—A 32-page bulletin, issued by the Sprague Electric Works of the General Electric Co., New York City, is devoted to the extensive line of cage controlled monorail hoists built by this company. These hoists operate on I-beam tracks, travel at a high rate of speed and can go anywhere that the single I-beam runway can be supported. These hoists are equipped with swivel trucks, enabling them to run around sharp curves so that with a properly designed runway system, with switches, turntables, etc., the hoists are able to pass one another and to convey their respective loads to their destinations without the delay caused by the traveling crane which usually occupies its entire runway. The bulletin is unusually well-illustrated with service views of these hoists in operation in various industrial plants. Monorails in casting plants are shown conveying hot metal, handling molding sand, handling a grab bucket, etc.

VOLUTE CENTRIFUGAL PUMPS. — A 36-page catalog, issued by the Worthington Pump & Machinery Corp., New York, illustrates and describes the extensive line of volute centrifugal pumps built by this company. These are constructed in three standard designs, namely single side suction type, double-suction solid case type and double-suction pump with horizontally split casing. These pumps are shown both direct-connected and belt-driven. A number of installation views also are included.

SAND-BLAST EQUIPMENT.—The extensive line of sand-blast machines built by the Hoevel Mfg. Co., New York City, is illustrated and described in a recently-issued 20-page catalog. Among the simpler machines built by this company are included a hose sand-blast and a machine with a stationary nozzle. Different types of revolving barrel machines are illustrated as well as several styles of rotary table sand-blast machines. A sand-blast machine adapted to the cleaning of long and flat pieces such as radiator loops, pipes, columns, plates, etc., also is shown. It is provided with two tables which operate in opposite directions. In addition to a sand-blast cabinet, a large sand-blast room is illustrated, as well as a large capacity room which is equipped with a track and turntable for the handling of trucks containing castings to be cleaned. A sand-blast room provided with a rotary floor also is shown and described, where table does not rotate continuously, but only at intervals and when desired. This rotary floor greatly facilitates the cleaning of castings and materially increases the capacity of the room. Numerous service views are included, one showing two rooms with rotary floors, one room with a track and turntable and the other illustrates Hoevel sand-blast equipment in a foundry, consisting of a sand-blast room, rotary table machine and a revolving barrel machine.

PATTERN SHOP MACHINERY. — An unusually complete catalog devoted to woodworking machinery, containing 304 pages, has been issued by the Oliver Machinery Co., Grand Rapids, Mich. Practically all of the tools essential to the modern pattern shop are illustrated and described in detail. Considerable space is devoted to the universal wood milling machine which is to the pattern-maker and his department what the universal milling machine is to the tool room. This machine is furnished with either motor or belt drive. A large number of detail illustrations are included showing the various operations which it can perform and samples of work also are shown including spiral, spur and worm gear patterns. This machine also is unusually well adapted to the production of core boxes and many specimens of the most intricate nature are illustrated. A wide variety of saws for pattern shop use also are shown. A combination pattern lathe with a 90-inch swing and furnished with any length of bed is introduced to the trade by this catalog. This tool combines the functions of ordinary turning with those of turning large diameter, long cylindrical pattern gearing, etc. Its movable carriage and tool post admits of performing an infinite variety of work. The alignment of the pillar is accomplised by loose keys which fit the various slots in the plate and it may be adjusted to operate upon the larger diameters or set directly underneath the center of the spindles to act as a bed for hand turning on small work. A patternmaker's gap lathe, also illustrated, is the result of a demand for a machine of large capacity which will occupy a minimum amount of floor space when engaging it on work of medium dimensions. The bed construction is in two sections, the upper being fitted to the lower in a dovetailed slide and is moved either by hand-wheel rack and pinion or by power, to and from the headstock to close and open the gap, by means of gearing that engages the rack on its lower side. A large number of safety devices also is shown, as well as patternmakers' supplies and small equipment.